ADDITIONAL NOTES ON THE GENUS *GMELINA*. II

Harold N. Moldenke

GMELINA L.

Additional & emended bibliography: Chaudhuri, Indian For. 51: 57--60, pl. 3, fig. 3. 1925; Gaussen, Leroy, & Ozenda, Précis Bot. 2: 406. 1982; Mold., Phytologia 55: 308--342 & 424--442. 1984.

GMELINA ARBOREA Roxb.

Additional bibliography: Mold., Phytologia 55: 424--442. 1984.

Streets (1962) provides dates and growth history of *Gmelina* introduction in the Fiji Islands, Ghana, Kenya, Malawi, Malaya, Nigeria, Sabah, Sierra Leone, Solomon Islands, South Africa, Tanzania, Uganda, and Zimbabwe.

A summary of the economic uses of *Gmelina arborea* follows, taken mainly from the works of Spach (1840), Dymock (1884), Dymock, Warden, & Hooper (1893), Pearson (1912), Kirtikar (1918), Bois (1928), Benthal (1933), Dastur (1952), Sastri (1956), Chopra & al. (1958), Irvine (1961), Jain (1964), Maheshwari & Singe (1965), Jain & De (1966), Burkill (1966), Patel (1968), Agarwal (1970), Rao (1970), and Hartwell (1971). The tree, being a pioneer, is able to crowd out undesirable grasses, such as *Imperata* where they pose a problem. It is valuable in afforestation and reforestation as a source of timber and paper-pulp. It coppices well and is suitable as a shade or ornamental tree in gardens, parks, or along avenues. Cubitt (1920) avers that it yields good firewood, but will not suppress lalang. Its young shoots are eaten by cattle (sometimes), antelope, and deer as fodder.

The roots are used as a bitter or bittersweet tonic, stomachic, laxative, galactogogue nerve tonic in epilepsy since remote times. They form one of the ingredients of the Ayuredic dasamula or "ten-roots" (along with *Desmodium gangeticum*, *Tribulus terrestris*, etc.) which is used in the treatment of many diseases; taken with licorice, honey, and sugar it increases the secretion of milk. In Bombay it is used as a demulcent in treating gonorrhea. The roots form an ingredient of various powders, balms, and enemas. The pulverized root is employed in treating gout, burning body sensations, fevers, indigestion, anasarcha, abdominal pains, and hallucinations. In northern India it is believed to have anthelmintic properties and is used to improve the appetite and to treat piles and abnormal thirst, tridosha and urinary discharges. As a ghee it is used to treat abdominal tumors; with clarified butter, to treat nasal polyps. A decoction of the root bark is used internally in treating snakebites and scorpion stings, but Kirtikar (1918) quotes Mhaskar & Caius to the effect thaT "All parts of the plant are equally useless in the antidotal treatment of snakebite or scorpion sting!" As one of five plant species, it is used in the treatment of intermittent and typhoid fevers.

The bark is used medicinally and also by arrak manufacturers to regulate the fermentation of toddy. It is employed as a bitter tonic and stomachic, considered useful in combating fevers and indigestion.

The wood is employed in the manufacture of decks of boats, cattle-bells, picture-frames, and sandals; in the English trade known and sold as gumhar. It is good, durable under water, and resembles teak in its color, compactness, easy workability, resistance to cold and humidity as well as to the serious ravages of termites and shipworms. It is used in naval construction, to makes small boats and canoes, and, in Burma, for mine-timbers. It is highly esteemed for planking, furniture, door panels, well-lining, house-posts, toys, drums, Indian musical instruments (like sitars), ornamental cabinet-work, carving, plates and trays, bridge construction, railroad ties, boxes and packing cases, carriages and palanquins, shafts, axles, and yokes, grain measures, agricultural instruments, tree-calipers, carved images, lacquered receptacles, and clogs. In Hindustan it is used to make the cylinders for dholucks drumps; in Assam it is employed in the making of dugouts, matchsticks, artificial limbs, native stethoscopes, and sluices. The wood-pulp is widely used worldwide for making wrapping, writing, and printing paper. In Bangladesh the wood is employed chiefly for boat- and ship-building. Pearl-ash or potash salts are derived from the burning of the wood, and a yellow dye is also obtained in this way.

Chopra and his associates (1958) summarize: "The root, fruit, bark and leaves of this plant have all been used in medicine, but the root and fruit are preferred.....Combined with liquorice, honey and sugar, it is considered to be galactagogue." They re-assert its use for snakebites and scorpion-stings and add that it is reputed to have anti-tubercular properties.

The flowers are used in treating leprosy and blood diseases. Their juice is said to be bitter, acrid, and astringent.

The fruits are described as both bitter and sweet, sour and acrid. They are used medicinally as a cooling agent, diuretic, tonic, aphrodisiac, and alterative, as an astringent to the bowels, to promote the growth of hair, and in treating leprosy, ulcers, and consumption, as well as strangury and abnormal vaginal discharges. It is said to be useful in treating vata, abnormal thirst, and anemia. The mesocarp is quite edible -- natives of India and Burma thoroughly rub the ripe fruits by hand, the rind is removed, then dried in the open sun, and finally boiled and eaten. The extract of the fruit is said to be useful in body rejuvenation and disease-resistance. In experimental rabbits it gave an indication of increased percentages of α-2 and γ globulin fractions, a gain in body weight, and an increase in alertness and physical behavior. It is used in many popular cooling decoctions in cases of fevers or bilious ailments. It also provides a very persisteny yellow dye.

The leaves are sometimes used as fodder by cattle. They contain apigenin, luteolin, quercetin, hentriacontanol, and beta-sitosterol as crystalline compounds. The additional presence of glycosides of flavones is suspected. The juice of the tender leaves, as a decoction, is demulcent; mixed with milk and sugar it is used in treating gonorrhea, coughs, and catarrh of the bladder. Externally applied, the juice is used as a lotion in treating ulcers and maggot-infested wounds and sores. A paste made from the leaves is applied to the head in treating headache during fevers. The leaves have been recommended and are used in Assam for raising eri silkworms when *Ricinus* or *Heteropanax* leaves are not available.

Gamble (1878) refers to the timber of this tree as "one of the best Lower Hill woods". In his 1902 work he cites *B.295* & *1425, C. 835, 959, 2775,* & *3549, E.676, 948, 1390, 1433, 2193, 2395, 3605, 3620,* & *3693,* as well as *Mendis 30* and *Nordlinger Sections Vol. 4,* as very good wood samples. The wood itself is described by Kribs (1968): color uniformly cream or light yellowish-brown, turning russet with age; luster high and silky; odor and taste not distinct. It is light and soft, with a specific gravity of 0.47 (air-dry) and weight of 30 pounds per cubic foot; grain straight and roey; texture medium; easy to work, takes a high lustrous finish; growth-rings indistinct, although the vessels are slightly larger at the beginning of the growth zone; vessels distinct without lens, not numerous, irregularly distributed to slightly echelon, solitary and in radial groups of 2--4, the tangential diameter 143 mu to 285 mu, averaging 220 mu; the lumina with tyloses; the pits alternate, 10--14 mu in diameter; fibers septate with simple pits; parenchyma vasicentric, 2--5 cells wide, confluent, connecting 2 or 3 pores and at certain intervals forming tangential bands resembling terminal; apotracheal diffuse; rays visible without hand-lens in the cross-section, not conspicuous in the radial section, of heterogeneous type III, 1--5 (mostly 3 or 4) cells wide and 15--25 cells high; lumina with yellowish gum; ray-vessel pits round to oval, simple to half-bordered; ripple marks absent; gum ducts absent. As to its economic use he says: "furniture and cabinets, interior finish, millwork, boatbuilding (decking and planking), musical instruments, boxes and carving. A substitute for Prima vera and Avodire." Normand (1931) also provides a detailed description of the wood anatomy.

Nair & Rehmann (1962) describe the pollen as 3-zonicolporate, the endocolpium very faint, the ectine surface reticulate. These characters apply also to the pollen of *G. asiatica* L. and *G. philippensis* Cham., but in the former the grains are smaller (39 x 26 mu) and in the latter larger (49 x 37 mu). In further detail, the pollen grains of *G. arborea* are prolate spheroidal, 39 x 35 mu (range 33--44 x 32--39 mu), the colpi ends are acute, tenuimarginate, the membrane minutely crustate, the apocolpium diameter is 3.5 mu, the endocolpium is very faint, the exine is 1.4 mu thick, and the ectine almost as thick as the endine and reticulate, the lumina small. These characters were taken from *Herb. Nat. Bot. Gard. Lucknow l68l0, SI. 270l* in the Lucknow herbarium.

Specimens of *G. arborea* with toothed or lobed leaves are usually from seedlings or from turions (watersprouts) and are discussed herein under f. *dentata*, which see. Hooker (1848) states in his specific description that the leaf-blades are either entire or lobed: his accompanying illustration depicts a flowering branch which bears one leaf with a single lobe.

Sastri (1956) informs us that "This handsome tree, which is never gregarious and nowhere very common, is a light demander, moderately frost-hardy and intolerant of excessive drought. It prefers moist fertile valleys with good drainage. Natural reproduction takes place in the rainy season soon after the drupes fall to the ground. Alternating heat and moisture are necessary to stimulate seed germination. Clear ground, especially freshly broken ground forms a favourable germinating bed; seeds lying among weeds and grass usually fail to germinate.

"Artificial reproduction may be carried out by direct sowing or by transplanting. Direct sowing in lines 10--12 ft. apart, with a distance of c. 1 ft. between the plants, has given good results. The plants are thinned out in the third year if necessary. Dibbling of seed (4--5 seeds at each peg) with a spacing of 6 ft. x 6 ft. and broadcast sowing also give satisfactory results. For transplanting purposes, seeds are sown in drills in nursery beds shortly before rains. Seedlings are transplanted in the first rainy season when 3--4 in. high. If the plants are to be kept for a year in the nursery they are pricked out to c. 9 in. apart in the first rains and planted out in the next rainy season with the stem pruned down to 2 in. and the root trimmed to 1 ft. A spacing of 6 ft. x 6 ft. is ordinarily suitable. The rate of growth is fast and the tree is well adapted for treatment as coppice....

Sastri continues: "The tree is browsed by animals. Damage is also caused by defoliators (*Calopepla* spp.) and borers (*Dihamnus* spp. and *Alicide* spp.). A fungus, *Poria rhizomorpha* Bagchee, causes stem and root diseases in shady, unfavourable and water-logged situations and in clayey soils....." He gives another detailed description of the wood and notes that it "seasons well without cracking or warping, but is slow to dry both in the open and in the kiln. Green conversion and open stacking with crossers under cover are recommended." In water it is quite durable and buried in soil lasts about 15 years. It is easy to saw and peels well on a rotary lathe, sometimes exhibiting a silvery sheen.

Sastri also reports that the fruits contain butyric acid, tartaric acid, resin. and saccharin. An alkaloid occurs in the bark and root, the latter also showing traces of benzoic acid, resin, and a saccharin compound. "The calorific value of the wood (silica-free ash, 1.54 percent) is 4,763 cal., 8,547 B.t.u. When subjected to destructive distillation, the following carbonization products are obtained: charcoal, 31.3; total distillate, 47.1; pyroligneous acid, 37.1; tar, 10.0; pitch and losses, 2.4; acid, 4.47; esters, 3.42; acetone, 2.38; and methanol, 1.23 percent. The non-condensable gases (1.88 cu. ft./ lb. at N.T.P.) contain: carbon dioxide, 59; carbon monoxide, 31.75; methane, 4.5; hydrogen, 4.15; and unsaturated hydrocarbons (as ethylene), 0.6 percent." Kapoor (1969) reports an unidentified alkaloid present. Gibbs (1974) reports tannin present, but cyanogenesis is absent from tested shoots and the bark gives a negative result in the Juglone test. He found leucoanthocyanin absent from the leaves.

Roxburg (1832) gives a fascinating account of his observations about the wood of *Gmelina arborea*, which he refers to as "A large timber tree, a native of the mountainous parts of India. Flowering time [is] the beginning of the hot season.....The wood of this tree is used for a variety of economical purposes by the natives of various countries where it grows. That of such trees as will square into logs from eighteen to twenty-four inches resembles Teak more than any other sorts I have yet met with. The colour is almost exactly the same, the grain rather closer, at the same time it is fully as light, if not lighter, and as easily worked. Some years ago I received......a large square log......which measured nearly thirty feet in length, and at the thickest end was full twenty-four inches square." He placed an outside plank of this log "in the river, a little above low water mark, exactly where the [ship]worm is thought to exert its greatest powers. After remaining three years in this situation.....the piece was cut....and....found....as sound and every way as perfect throughout, as it was when first put into the river. Amongst other things, a valuable floor door was made of it, to keep the tide out of the [Calcutta] Botanic Garden. It is now seven years and a half since the door (which is four feet square) was made, and though much exposed to the sun and water, yet it remains good; while similar doors, though much smaller, made of Teak, were so much decayed, a year ago, as to render it necessary to replace them.

"In addition to my own experiments", he continues, "I have lately learned that the decks of pinnaces to the eastward, about Chittagong, Datta, &c. are made of this timber, because it bears the weather better than any other [timber] they know without shrinking, or warping." He adds that it is his opinion that this wood would be useful "for the bottoms, and upper works, of vessels, as well as for knees, curved timbers, &c."

Jan & Tarafder (1970) list the medicinal uses of *G. arborea*, with source references for each, in the treatment of swelling of the throat and choking, dropsy and anasarca, spleen troubles, pains, rheumatism, rigid thigh, jhangibat, jhunka bat, epilepsy, convulsions, colic, mad convulsions and fits, delirium, tihurla mirgibai, smallpox, syphilis, sores, urticaria, dyspepsia, cholera, phthisis, bronchitis and asthma, diarrhea, intoxication, blackness of lips and tongue, the bite of rats, tigers, crocodiles, snakes, lizards, etc., hemorrhagic septicemia, rinderpest, anthrax, and gravel. Truly the original wonder-drug!

Odeyemi (1970) found the total lignin in *G. arborea* wood to be 31 percent (plus or minus 1 percent). The most favorable sulphuric acid concentration for the solution of this lignin in wood pulp preparation is 66--74 percent. A higher percentage could be used with good results only if the reaction time is less than one hour. The primary hydrolysis reaction could be carried out advantageously under the tropical laboratory room temperature of 28--30° C. The use of a mixture of sulphuric acid (sp. gr. 1.84) and HCl (sp. gr. 1.18) in the ratio of 2:1 or 1:1 by volume is recommended.

López-Palacios (1982) records the use of this plant in the treatment of asthma in Venezuela.

Joshi & Singh (1970) report obtaining a new lignin (gmelinol) from the aqueous extract of the heartwood, while from the benzene extract of the same heartwood was isolated η-octanosanol. Luteolin was isolated from the leaves by Venkata Rao and his associates (1967). Gibbs (1974) found syringin absent from the stems and reports a negative result with the HCl/methanol test.

Lamb (1970) warns of the risks inherent in *Gmelina* monoculture: "Los forestales que trabajan en los trópicos deben considerar los riesgos que implica el cultivo de *Gmelina* en plantaciones puras. Existe el riesgo de deterioro del suelo por estar éste expuesto en una plantación de esta especie decidua; el riesgo de la erosión del suelo si el fuego barre la hojarasca, y el riesgo de un araque tanto de insectos como de hongos, que es común a todos los rodales puros, y que puede resultar catastrófico. El deterioro del suela por exposicion es mucho mayor en zonas de elevada precipitación y con suelos arenosos, tal como ocurre en los distritos de Benin y en Enugu, Nigeria, donde debería alentarse un piso inferior para *Gmelina* en plantaciones destinadas a producir madera de obra. Si se cultiva para producir pulpa en rotación de monte tallar, el riesgo es mayor; no es posible ningún piso inferior y se debe tener mucho cuidado con esta contingencia cuando se proyectan plantaciones para producir madera de pasta. La acción del fuego acelera el deterioro del suelo y debería ser totalmente excluida de las plantaciones de *Gmelina* mediante métodos eficaces de protección."

Browne (1968) paints a rather bleak picture as to the susceptibility of *Gmelina arborea* to attack by disease and pests. As enemies he lists no less than 7 species of fungus, a mistletoe, a mollusk, a myriapod, 5 kinds of mammals, and 44 species of insects. His list, supplemented by reports from other investigators [Singh (1972), Lamb (1968), Raman & Das (1980), King (1966)], is as follows:

Fungi: *Armillaria mellea*, *Cercospora ranjita*, *Fomes lignosus*, *F. roseus*, *Ganoderma colossum* [*Phaeolus manihotis*], *Polyporus baudoni*, *Poria rhizomorpha*, *Sclerotinia* [*Sclerotium*] *rolfsii*, *Trametes straminea*.

Mistletoes: *Dendrophthoë falcata*, *Tapinanthus* sp. aff. *T. globifer*. King notes that plantations of this tree in West Bengal are famous examples of the destructive propensities of what he calls *Loranthus longiflorus* and especially of its var. *falcatus*.

Mollusks: *Limicolaris aureus*.

Nematodes: *Xiphinema* sp. Raman & Das report the abundance of this nematode as averaging 21 per 250 g. of forest soil.

Myriapods: *Odontopyge* sp.

Bees: *Xylocopa inconstans*.

Ants: *Atta* sp. Lamb reports leaf-cutter ants very destructive.

Beetles: *Alcidodes ludificator*, *Apion angulicolla*, *A. armipes*, *Apophylla* [*Apophylia*] *chloroptera*, *A. nigricollis*, *A. sulcata*, *Calopepla leayana*, *Chrysolagria naivashiana*, *Curimosphaena villosus*, *Dihammus cervinus*, *Doliopygus conradti*, *Ecnomaeus planus*, *Empecamenta calabarica*, *Lagria villosa*, *Lixus camarunus*, *L. spinimanus*, *Macrocoma candens*, *Platypus hintzi*, *Podagrica dilecta*, *Prioptera punctipennis*, *Siderodactylus sagittarius*, *Sphenoptera reticulata*, *S. zechiana*, *Xyloborus ferrugineus*, *X. fornicatus*.

Hemipterous bugs: *Agaeus pavimentatus*, *Anoplocnemis curvipes*, *A.*

tristator, Atekocera raptoria, A. strictior, Chunrocerus niveosparsus, Dysodercus superstitiosus, Homoeocerus pallens, Tingis beesoni, Trioza fletcheri.

Isopods: *Coptotermes curvignathus, C. niger, Macrotermes goliath.* Lamb states that termites usually do little damage except sometimes to the heartwood near the ground.

Lepidopterons: *Achaea eponina, A. lienardi, Acrocercops telestis, Bunaea alcinoë, Catopsilia florella, Diacrisia lutescens, D. maculosa, Endoclita* [*Phassus*] *undulifer, Euchromia lethe, Eupterote geminata, E. undata, Gonodontis clelia, Imbrasia obscura, Indarbela quadrinotata, Metanastria hyrtaca, Myrina silenus, Parasa ananii, Phostria caniusalis, Pionea aureolalis, Psilogramma menephron, Sahyadrassus malabaricus, Selepa celtis, Xuleutes ceramica.*

Orthopterons: *Gryllus posticus, Heteropternis thoracica, Kraussaria angulifera, Phaneroptera nana, Phymateus viridipes, Zonocerus elegans, Z. variegatus.*

Mammals: *Axis axis, Strepsiceros strepsicerus* (kudu), *Sylvicapra grimmia* (gray duiker), *Thryonomys swinderianus* (great cane rat), *Tragelaphus scriptus* (harnessed antelope).

Muchovej and his associates (1978) report *Ceratocystis fimbriata* as parasitic on *Gmelina arborea.* Kochar and his associates (1972) report that, at least in laboratory experiments, *Aedes* mosquitoes (*Stegomyia* spp.) show a marked preference to *Gmelina arborea* timber for their oviposition, second only to the timber of *Cedrus deodara.*

Govindachari and his associates (1972) report the isolation of a new tetrahydrofuranoid lignan, arboreal, from the heartwood of *Gmelina arborea.* It is a long-chain ester, 1-hydroxyl-2-methoxy-2, 6 bis (3,4-methylenedi-oxyphenyl)-3,7-dioxobicyclo [3.3.0] octane. This is said to represent the first instance of a naturally occurring tetrahydrofuranoid lignan [cluytyl ferulate] substituted at the benzylic carbon level. It is produced also in the heartwood of *Lannea grandis.*

Rao and his associates (1967) found luteolin present in the alcoholic extract of *Gmelina* leaves, while Joshi and his associates (1977) isolated from a light petroleum extract of the roots the following chemical compounds: hentriacontanol-1, a sesquiterpene, ceryl alcohol, β-sisterol, and n-octacosanol; the aqueous extract yielded gmelinol.

Anjaneyulu and his associates (1977) isolated no less than six new lignans from the heartwood. These are 6"-bromo-isoarboreol, 4-hydroxysosamin, 4,8-dihydroxysesamin, 1,4-dihydroxy-sesamin (gummadiol), 2-piperonyl-3-hydroxymethyl-4-(α-hydroxyl-3,4-methylenedioxylbenzyl)-4-hydroxytetrahydrofuran, and the 4-C-ɔ flucoside of 4-epigummadiol.

Dymock, Warden, & Hooper (1893) report that the ash of powdered roots of *Gmelina arborea* is free of manganese. The petroleum ether extract has some slight siccative properties, contains resins and a trace of an alcoholic principle. The fruit has been found to contain butyric and tartaric acids, some astringent matter, an alkaloid, a resin, and a saccharin.

Common and vernacular names for *Gmelina arborea*, including orthographic variants, are the following: álamo blanco, álamo ofón, anvong, anyong, arisa, ashveta, atdemmata, at-dem-mata, at-demmata, bachanige, ban, bari, batinj, bhadraparni, bhodropornni, bol-gi-ppok, bolkobak, bolko bak, candabar tree, candahar tree, cashmere tree, challagummudu, chimman, ciruela de Malaya, comb tree, coomb tree, cumbulu, cummi, dieng-lophiang, et demata, et-demata, et-dembata, eth demata, eth-demata, eth-demeta, gam, gamair, gamar, gamari, gamári, gámári, gambar, gámbár, gambari, gamberi, gambhar, gámbhár, gambhârî, gambhari, gamhar, gamhār, gaminea, gammari, gamri, ganghari, gandharya, gmélina élancé, gomari, gomghari, goomadee, goomar-tek, goomar teak, goombar, gopadhadrika, grishti, guma, gumadi, gumai, gumaldi, gumar, gúmár, gumartek, gúmar-tek, gumbar, gumbár, gümbar, gumbari, gumbhar, gúmbhar, gumbhár, gumbharee, gumbhari, gumbhir, gumbor, gumhar, gumhār, gumhár, gúmhár, gumher, gummadi, gummudu, gumudu, gumteku, gumudu-takku, gumudu teku, gumuduteku, gumudu téku, gumur, gupsi, gupsiro, hira, imbeh-ching, Indian bulang, jemane, jobo de Africa, joogani-chookar, jugani-chukur, kainadu, kaju titi, kakodumbari, kákódúmbári, kalarbadi, kamar, kambar, kambhar, kambhari, kambhári, kambharika, kasamar, kashamari, kashmar, kashmiri, kashmaryya, Kashmir tree, Kashmir-tree, kashmori, kasmar, kasmár, kasmardaru, kasmari, kásmari, kasmaryamu, kasmiri, kasmiri-mara, kasomhardaru, kassamar, kássamar, kataphala, kattanam, khamar, khamara, khamāra, khamari, khambhari, khambhári, khammara, khamnar, krishna, krishnaphala, krishnavrintika, kshirini, kule, kuli, kull, kumadi, kumahr, kumala, kumar, kūmār, kúmár, kumara, kúmár-gambari, kumbal, kumbhar, kumbhár, kumbil, kumbili, kumbudi, kumbulu, kumhar, kumhar, kumhār, kumhár, kúmhár, kumhar tree, kumher, kumil, kumuda, kumule, kunbhir, kurasmara, kurse, kursi, kyunboc, kyúnboc, kywonpho, kywon-pho, lói, loi tho, lói tho, madhubhadra, madhumati, madhuparnika, madhurasa, mahabhadra, mahakumuda, mai-sau, Malay beechwood,, Malay bush beech, Malay bushbeech, melina, modini, numbon, numbong, numbor, numbór-kúng, pedda-gomra, pedda gomru, peddagomru, peddagumudu, pedda gumudu téku, peddagumudutekku, peddah gomra, peddu gumu, perungumil, perungumpil, phang-arong, pitaphala, pitarohini, pulir-gumil, ramani, rohini, rom ma, sadabhadra, sag, sarvatobhadra, sarvatobhadrika, savan, saw, sevan, seven, sewan, sewān, sewun, shevan, shevana, shewan, shewney, shewun, shewunee, shivan, shivani, shivannigida, shiwali, shiwan, shiwani, shiwun, shíwun, shripani, sirna, sivan, sivony, snapdragon tree, snigdhaparni, sripmari, sthulatvacha, subhadra, sudridhatvacha, suphala, svarubhadra, tagoomooda, tagumúda, tall beechberry, teggummadu, teggummodu, thlan-vong, tho, tree gmelina, tree verbena, triparni, umi, umitekku, umi-thekku, vataha, vidari, vidarini, wang, wareng, white teak, yá má ne, yamanai, ya-ma-nay, yamane, yemane, yemani, yemene, and yémené.

Several authors, notably Clarke (1885), Fernandez-Villar (1880), Collett & Hemsley (1890), Trimen (1895), Hallier (1918), Ali (1932), Dop (1935), Petelot (1953), Fletcher (1938), and Cooke (1958) list *Gmelina arborea* from the Philippine Islands, but Merrill (1923) assures us that the species does not occur in these islands. Uphof (1968) records it from the "Pacific Islands", specifically Fiji, but this is doubtless also the result of a misidentification, in this case for *G. vitiensis* Seem.

It should be noted that the Roxburgh (1815) to *G. arborea* is cited as "1819" by Stapf (1930), Taylor (1959), and Trimen (1895) and as "1814" by Fletcher (1938) and Merrill (1941). The Roth (1821) reference is often mis-cited as "1825".

Among the bibliographic references said to refer to *Gmelina arborea*, but not as yet seen by me for verification are volumes 1 and 2 of a work by Charaka-Samhita, translated by A. C. Kaviratna (1718 pp., Corinthian Press, Calcutta), "The Bower Manuscript", by A. F. R. Hoernle, 1893--1912 (401 pp., Supt. Govt. Printing, Calcutta), and Kraener's "Materia Medica of Ceylon".

Material of *Gmelina arborea* has often been misidentified and distributed in herbaria as *Premna tomentosa* Willd. On the other hand, the *Avery 442, Clemens 43318a, Herb. Hort. Bot. Calcut. s.n., Liogier 2l476, Maxwell 76-58, Naudan 76, Nicolson 3138,* and *Perrottet 483* (and possibly *Singh 333*) are *G. arborea* var. *canescens* Haines, *A. Shah s.n.* [14-3-22] is the type collection of f. *dentata* Mold., *Duthie 22451, Herb. Bot. Gard. Trin. 35l6, Kand 4-81, Khajuria s.n.* [May 14, 1928], *López-Palacios 3096, Scully 191, Srinivasan s.n., Troth 755,* and *Vidal 5856* are var *glaucescens* C. B. Clarke, *Yip 232* is *G. chinensis* Benth., *Maxwell 75-318* is *G. elliptica* J. E. Sm., and *Jameson s.n.* is *Callicarpa nudiflora* Hook. & Arn. *Hosseus 476* is a mixture of *Gmelina arborea* and *Columbia floribunda* in the *Tiliaceae*. *Nafday 174* does not actually indicate on the collector's label that it was collected from cultivated material, but I am assuming that it was. The label accompanying *Mejía 253* states "Arbol de 3.5 cm. de alt." -- surely an error for 3.5 m.

Citations: TANZANIA: Tanganyika: *Burtt 6298* (Br). MALAWI: *E. Phillips 2773* (Ba--378289). PAKISTAN: Northwest States: *Duthie s.n.* [Dudhwa range, 8-4-98] (Gg--127012); *Ibrahim s.n.* [Jan. 1971] (Gz--wood sample). INDIA: Assam: *Chand 1443* (Mi), *3045* (Mi), *4398* (Mi), *4603* (Mi), *7476* (Mi), *8344* (Mi); *Chatterjee s.n.* [May 1902] (Po--63435); *Koelz 29685* (Mi), *33086* (Mi). Bihar/Orissa: *Nusker 40* (Mu--3942). Gujarat: *Santapau l679* (N). Karnataka: *Saldanha 12346* (W--2794840), *12824* (W--2794841), *13298* (Mi, W--2653635), *16581* (W--2653619); *G. Thomson s.n.* [Mysore & Carnatic] (Pd). Kerala: *Hohenacker 554* (Mu--741), *757* (Mu--1603). Tamil Nadu: *Perrottet 483* (V); *Yeshoda 374* (N). Union Territory: *Perrottet s.n.* [Pondichéry 1835] (Br, W--2496330). Uttar Pradesh: *U. Singh 332* (Dp--30951), *333* (La); *Srinivasan s.n.* [Ramnagar, Feb. 1931] (N), *s.n.* [Dehra Dun, June 1931] (N); *Strachey & Winterbottom s.n.* [Bhabar of Kumaon] (Br). State undetermined: *Wight 2322* (T). SRI LANKA: *Gardner s.n.* [Thwaites C.P.128] (Pd, Pd); *Hallier C.243* (Hg, Le), *C.3514* (Hg, Le); *Jayasuriya 1989* (Ac, Ld, W--2808349); *Meebold 3837* (S); *Moldenke, Moldenke, Jayasuriya, & Sumithraarachchi 28312* (Ac, E, Gz, Kh, Ld, Pd, Pd, W--2764499); *Rudolf s.n.* [Feb. 1896] (Mi); *Sumithraarachchi & Fernando DBS.161* (Ld, W--2803397), *663* (W--2808355); *Worthington 887* (K), *2787* (K), *2824* (K), *6266* (K), *6777* (K, K). BANGLADESH: *Majumder & Islam 38* (Mi), *MADW.24489* (Ws, Ws). BURMA: Upper Burma: *F. K. Ward 493* (N). CHINA: Yünnan: *A. Henry 12886* (N--photo, W--

459348). THAILAND: *Bumphang 1080* [Herb. Roy. For. Dept. 26234] (S); *Herb. Roy. For. Dept. 92* (N); *Hosseus 476* in part (Mu--4197); *Hokkamkaeng 4* [Herb. Roy. For. Dept. 4399] (W--2064800); *Kostermans 85* (Bz--73296); *Koyama, Phengklai, Niyondham, Tamura, Okada, & O'Connor 15535* (Ac, N); *Sangkhachand 780* [Herb. Roy. For. Dept. 22711] (Gg); *Sørensen, Larsen. & Hansen 6960* (Ld). VIETNAM: Annam: *Poilane 13635* (B). MALAYA: Selangor: *Poore 361* (Kl--361). GREATER SUNDA ISLANDS: Sabah: *Kadir s.n.* [Herb. N. Born. For. Dept. 971) (W--2317108); *Kanis & Sinanggui SAN.52638* (Ld). CULTIVATED: Brazil: *A. Gentry 12805* (N); *Pereira 366* (W--2962201). Dominica: *L. H. Bailey 809* (Ba). Dominican Republic: *Mejía 253* (N). Egypt: *Mahdi s.n.* [17/5/1966] (Gz, Gz). Florida: *Avery 442* [P.2737] (Ba). Hawaiian Islands: *Herb. Haw. Sugar Pl. Assoc. Exp. Sta. s.n.* [October 13, 1940] (Bi). Honduras: *Molina R. 27891* (Mi, N, W--2735847). India: *Herb. Hort. Bot. Calcut. s.n.* (B); *Nafday 174* (Ba); *Roxburgh s.n.* (Br--isotype, Br--isotype, Br--isotype, F--photo of isotype, Ld--photo of isotype, N--isotype, S--photo of isotype). Java: *Herb. Hort. Bot. Bogor. XI.1.37* (Bz--25842, Bz--25843, Bz--25844, Bz, Bz, Bz), *XI.5.37* (Bz--26553, Bz--26554). Mexico: *Wendt, Villalobos C., & Olmstead 2916* (Ld). Nicaragua: *W. D. Stevens 20955* (Ld). Singapore: *Furtado 385* (Ca--343115). Sri Lanka: *Moldenke, Moldenke, & Jayasuriya 28141* (Ld, Pd, W--2764416), *28177* (Ac, Pd, W--2764451); *Moldenke, Moldenke, & Sumithraarachchi 28200* (Gz, Ld, Ld, Pd, W--2764461). Trinidad: *W. E. Broadway Trin. Bot. Gard. Herb. 3516* (R). Venezuela: *Marcaño-Berti 2026* (Ld). MOUNTED ILLUSTRATIONS: Hook., Curtis Bot. Mag. 73 [ser. 3, 4]: pl. 4395 (Ld); López-Palacios, Fl. Venez. Verb. [319], fig. 76. 1977 (Ld); H. N. Moldenke color slide 178 (Ld).

GMELINA ARBOREA var. *CANESCENS* Haines, For. Fl. Chota Nagpur 487. 1910.

Bibliography: Haines, For. Fl. Chita Nagpur 487. 1910; Haines, Bot. Bihar Orissa, ed. 1, 4: 719. 1922; Osmaston, For. Fl. Kumaon 409. 1927; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 127 & 186. 1949; Mold., Résumé 163, 166, 218, & 456. 1959; Haines, Bot. Bihar Orissa, ed. 2, 2: 754. 1961; Mold., Résumé Suppl. 16: 9. 1961; Mold., Fifth Summ. 1: 276, 283, & 362 (1971) and 2: 879. 1971; Mold., Phytologia 28: 449 (1974), 31: 391 (1975), 34: 363 & 369 (1976), and 36: 38. 1977; Mold., Phytol. Mem. 2: 257, 262, 273, 286, 354, & 549. 1980; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 393 & 394. 1983; Mold., Phytologia 55: 334. 1984.

This variety differs from the typical form of the species by its lower leaf-surface being merely gray-pubescent with simple hairs, not stellate-tomentose with branched hairs.

Osmaston (1927) states that this plant "occurs throughout the [Kumaon] area up to 3,000 feet. Fairly common in the Bhabar but not common in the hills". He asserts that in that area of India it flowers in March and April and fruits in May and June. Haines (1922) describes the leaves as subcoriaceous, only 3--6 inches long, the tertiary veins strongly elevated beneath, and the flower- or fruit-panicle strict, only 3--4 inches long. He lists the variety from the Santal Parganas in Bihar/Orissa, where, he avers, "The wood is largely used for making drums. It is white, easily worked and does not warp or shrink. It should be more widely propagated." He continues with quotations from Roxburgh, Gamble, and Dutt relative to the economic uses of the plant, but these all apply to the typical form of the species, although it seems most probable that most, if not all, of the uses described for the typical form would apply also to the varieties.

Recent collectors describe this plant as a tree, 6--10 m. tall or (according to Nicolson) to 100 feet tall, nearly leafless during anthesis, the branches wide-spreading, the inflorescence-axis greenish, the flowers fragrant, the calyx greenish, and the fruit at first green, later pale lemon-yellow. The corollas are described as "red-brown, the lip yellow" on *Chand 1582*, "madder, the lip yellow" on *Koelz 29854*, "brownish, the lip yellow" on *Nicolson 3138*, "lip and throat yellow" on *Dwyer & al. 286*, "brown outside, yellow inside" on *Liogier 21476*, and "tube and lobes brown-orange, large lip and throat yellow" on *Maxwell 76-58*.

Recent collectors have encountered the plant at altitudes of 200 to 1300 meters along streams in deciduous forests, in flower from February to April and in fruit from February to June.

Clemens, in Australia, notes that there "the flowers and leaves are sought by cattle". Pereira describes the flowers as "pardas, com fauce amarelada".

The *Dwyer & al. 286* collection, from Belize, cited below, bears no indication on its accompanying label that it represents cultivated material, but I am assuming that it, like the Australian material, was taken from experimental plantations.

Material of this variety has almost uniformly been identified and distributed in herbaria as typical *G. arborea* Roxb.

Citations: NEPAL: *Nicolson 3138* (Mi, W--2571598). INDIA: Assam: *Chand 1582* (Mi); *Koelz 29854* (Mi). Chota Nagpur: *Kerr 2178a* (W--2963759). Union Territory: *Perrottet 483* (Mu--1146). Uttar Pradesh: *Naudan 76* (Ca--304519); *Qureshi s.n.* [30th March 1929] (W--1716611), *s.n.* [18th May 1929] (W--1716611), *s.n.* [12th April 1930] (W--1719649); *Singh 333* (N); *Wali 79* (W--1347686), *83* [April] (W--1347728), *83* [September] (W--1347728). West Bengal: *Mukerjee 1517* (S). BURMA: Upper Burma: *Herb. Burma For. School 101* (N). THAILAND: *Maxwell 76-58* (Ac). CULTIVATED: Australia: *M. S. Clemens 43318a* (Mi). Belize: *Dwyer, Elias, & Maxwell 286* (E--2071717). Brazil: *Pereira 366* (N). Cuba: *Eames s.n.* [April 8, 1948] (It). Dominican Republic: *A. H. Liogier 21476* (N, W--2753334). Florida: *Avery 442* (Ft--8965). India: *Herb. Hort. Bot. Calcut. s.n.* (Mu--737). Java: *Herb. Hort. Bot. Bogor. s.n.* (Bz--21047).

GMELINA ARBOREA f. juv. DENTATA Mold., Phytologia 8: 14. 1961.

Synonymy: *Gmelina rheedii* Hook., Curtis Bot. Mag. 74 [ser. 3, 4]: pl. 4395 in part. 1848. *Gmelina rheedi* Hook. ex Mold., Phytol. Mem. 2: 408 in syn. 1980

Bibliography: Hook., Curtis Bot. Mag. 74 [ser. 3, 4]: pl. 4395. 1848; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1040. 1890;

Troup, Silvicult. Indian Trees 2: 770/771, fig. 294. 1921; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 1040 (1946) and imp. 3, 1: 1040. 1960; Mold,, Phytologia 8: 14. 1961; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Biol. Abstr. 37: 1062. 1962; Mold., Résumé Suppl. 3: 17. 1962; Mold., Fifth Summ. 1: 276 (1971) and 2: 879. 1971; Mold., Phytol. Mem. 2: 263 & 549. 1980; Mold., Phytologia 54: 238 & 243. 1983; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 391. 1983; Mold., Phytologia 55: 334. 1984.

Illustrations: Hook., Curtis Bot. Mag. 74 [ser. 3, 4]: pl. 4395 (in color), 1848; Troup, Silvicult. Indian Trees 2: 770/771, fig. 294 (in color). 1921.

This is a juvenile form of the species seen mostly on seedlings and watersprouts from old stumps, but occasionally on mature flowering and/or fruiting trees, of no taxonomic significance. It is characterized by 2 or 3 large, lobe-like, triangular teeth on the leaf-margins. It is based on an unnumbered collection made by Azizullah Shah at Jhajra in Siwalik/Jaunsar, India, on March 14, 1922, deposited in the herbarium of the University of California at Berkeley.

The original description of *Gmelina rheedii*, as well as the accompanying illustration, indicate leaves that are either entire or lobed, the illustration showing a flowering branch with one leaf exhibiting a single lobe.

Material of this form has uniformly been distributed either as typical *G. arborea* Roxb. or as its var. *glaucescens* C. B. Clarke.

It is very possible that *G. sinuata* Link may belong here -- see my discussion under that taxon in this series of notes.

Citations: INDIA: Siwalik/Jaunsar: *A. Shah s.n.* [14-3-1922] (Ca--228226--type). Uttar Pradesh: *Bakhsh 91* (N); *R. M. Mukherjee 89* [28th April] (W--1170155), *89* [27th May] (W--1170155).

GMELINA ARBOREA var. *GLAUCESCENS* C. B. Clarke in Hook. f., Fl. Brit. India 4: 582. 1885.

Synonymy: *Gmelina arborea* var. *glaucescens* C. B. Blake ex López-Palacios, Revist. Fac. Farm. Univ. Andes 20: 24 sphalm. 1979.

Bibliography: C. B. Clarke in Hook. f., Fl. Brit. India 4: 582. 1885; Haines, For. Fl. Chota Nagpur 487. 1910; Haines, Bot. Bihar Orissa, ed, 1, 4: 719. 1922; Osmaston, For. Fl. Kumaon 409. 1927; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 127 & 186. 1949; Mold., Résumé 163, 218, & 456. 1959; Haines, Bot. Bihar Orissa, ed. 2, 2: 754. 1961; Mold., Résumé Suppl. 18: 8. 1969; Mold., Fifth Summ. 1: 270, 271, 276, & 363 (1971) and 2: 879. 1971; Mold., Phytologia 23: 423 (1972), 26: 368 (1973), 28: 443 & 449 (1974), and 34: 269. 1976; López-Palacios, Fl. Venez. Verb. 318--319 & 649. 1977; López-Palacios, Revist. Fac. Farm. Univ. Andes 20: 24. 1979; Mold., Phytol. Mem. 2: 256, 257, 263, 273, 354, 408, & 549. 1980; Mold., Phytologia 50: 255. 1982; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 389 & 394. 1983; Raj, Rev. Palaeobot. Palyn. 39: 356, 372, & 395. 1983; Mold., Phytologia 55: 335. 1984.

This variety differs from the typical form of the species in the lower side of its mature leaves being glabrous and glaucous, the glaucous appearance being due to dense microscopic glands or scales which are also present but hidden by the pubescence in the other forms of the species. The tertiary veins are not elevated beneath or only slightly so and the flower- and fruit-panicle is usually large. The calyx-teeth are mostly larger and triangular.

The variety is based on an unnumbered collection by J. D. Hooker and his associates from "Subtropical Himalaya and Khasia Mts. [Assam, India], alt. 0--2000 ft.", deposited in the Kew herbarium. Clarke (1885) cites also an unnumbered Kurz collection from "Burma and Tenasserim" and notes that the variety is "Probably only the form of *G. arborea* from moist places; some N. W. Himalayan examples are intermediate between it and the type". This "intermediate" form is probably the var. *canescens* of Haines described above.

Haines (1922) avers that var. *glaucescens* is found throughout the range of the species as a whole and is more common in Bihar/Orissa than the typical form.. The var. *glaucescens* is known definitely from northern Pakistan, Nepal, and through northern India and Bangladesh to Burma, where it extends south to Tenasserim. It is rather widely cultivated in tropical Asia, Java, Florida, Germany, and elsewhere, mostly for ornament or as a specimen tree. López-Palacios (1977) lists it as cultivated in Aragua, Barinas, Bolívar, and Mérida, Venezuela.

Raj (1983) has studied the pollen of this tree on the basis of an unnumbered Kar collection from Siwalik, India, deposited in the Stockholm herbarium.

Collectors describe the plant as a large or medium-sized tree, 8--10 m..tall, the leaf-blades 6--10 inches long, basally cordate, with glands on the lower surface, and with "white spots" (*Choudry 106*). They have encountered it in *Bombax-Trewia* riverine forests, at 180 m to 4000 feet altitude, and record the vernacular names "gambar", "gumhar", and "so". In Sri Lanka it has been introduced in an area of 60 inches annual rainfall. Scully asserts that it is "occasionally" planted in Guam.

Material of this variety has been misidentified and distributed in some herbaria as typical *G. arborea* Roxb., *G. sinuata* Link, and even as *Hernandia* sp. On the other hand, the *Bakhsh 91*, distributed as *G. arborea* var. *glaucescens*,actually represents *G. arborea* f. juv. *dentata* Mold.

Citations: PAKISTAN: Northwest States: *T. Thomson s.n.* [3000 ped.] (Pd). NEPAL: *Troth 755* (W--2826489). INDIA: Sikkim: *J. D. Hooker s.n.* [Sikkim, 1--4000 ped.] (M, Mu--736, Pd, S). Siwalik/Jaunsar: *Choudry 106* (Pd); *Kar s.n.* (S). Uttar Pradesh: *Dorji 35* (N); *Duthie 22451* (Ca--269790); *Ghazanfartli s.n.* (N); *Kand 4-81* [April] (W--1372660), *4-81* [July] (W--1372660); *Khajuria s.n.* [May 14, 1928] (W--1716393); *Srinivasan s.n.* [Dehra Dun, Jan. 1975] (N), *s.n.* [Remnegar, Feb. 1975] (N). State undetermined: *Hamid 14-8l* [Kalsi] (Pd); *Khoshoo s.n.* [Dulani Choki] (S); *Lakhera s.n.* [Duran Choki] (S). LAOS: *Vidal 5856* (W--2800872). CULTIVATED: Florida: *H. N. Moldenke 21448* (Hk, Ss). Germany: *Herb. Kummer s.n.* [Hort. bot. monac. 1856.II.12] (Mu--1371), *s.n.* [Hort. bot. monac. 1856.I.

12] (Mu--1370). Guam: *Scully 191* (W--2920686). India: *Wallich 1817/5* (Pd). Java: *Herb. Hort. Bot. Bogor. XI.G.80* (Bz--25789), *XV.F.13* (Bz--26312). Sri Lanka: *Worthington 5932* (K). Trinidad: *Herb. Bot. Gard. Trin. 3516* (W--940087). Venezuela: *López-Palacios 3096* (Ld, N). Zululand: *Prior s,n,* (Cb). LOCALITY OF COLLECTION UNDETERMINED: *Herb. Torrey s.n.* (T).

GMELINA ASIATICA L., Sp. Pl., ed. 1, imp. 1, 2: 626. 1753 [not *G. asiatica* Auct., 1917, nor Blanco, 1837, nor Burm., 1921, nor Kurz, 1980, nor Lour., 1790, 1954, nor Schau., 1918, nor Wall., 1831].

Synonymy: *Arbuscula bisnagarica aceris folio parvo aculeata, foliis e regione binis* Pluk., Almag. Bot. Phyt. 1: pl. 14, fig. 4. 1691. *Lycium maderaspatanum indici, alpino putati aemulum, foliis minoribus & majoribus bijugis, & grandioribus aculeis horridis* Pluk., Almag. Bot. Phyt. 5: pl. 97, fig. 2. 1700. *Dematha zeylanensibus* P. Herm., Mus. Zeyl., ed. 1, 3, 9, 12, & 21. 1717. *Michelia spinosa, floribus luteis* Amman, Comment. Acad. Sci. Imp. Petrop. 8: 218--219, pl. 18. 1736. *Prunus indica sylvestris, fructu flavo, pyriformi* Burm., Thes. Zeyl. 197. 1737. *Prunus indica sylvestris, fructu flavo pyriformi* Burm, apud P. Herm. in L., Fl. Zeyl., ed. 1, 103 in syn. 1747. *Lycium maderaspatanum indici alpino putati aemulum, foliis minoribus (& majoribus) bijugis & grandioribus aculeis horridum]* Pluk. apud P. Herm. in L., Fl. Zeyl., ed. 1, 103 in syn. 1747. *Gmelina coromandelica* Burm. f., Fl. Indica 132. 1768. *Gmelina parvifolia* Roxb., Pl. Coromand. 2: 32, pl. 162. 1798. *Gmelina parviflora* Roxb. es Pers., Syn. Pl. 2: 142. 1807. *Premna parvifolia* Roth, Nov. Pl. Sp., imp. 1, 288--289. 1821. *Gmelina inermis* Wight ex Wall., Numer. List 87, no. 1816D. 1831 (not *G. inermis* Blanco, 1837, nor Naves, 1880, 1918). *Michelia spinosa* Amman apud Schau. in A. DC., Prodr. 11: 679 in syn. 1847. *Gmelina coromandeliana* Burm. apud Schau. in A. DC., Prodr. 11: 679 in syn. 1847. *Gurelina asiatica* L. ex Wight, Illust. Indian Bot. 2: pl. 174. 1850. *Gmelina parvifolia* Sch. ex Miq., Fl. Ned. Ind. 2: 867 in syn. 1858. *Premma parvifolia* Roth apud Miq., Fl. Ned. Ind. 2: 866--867 in syn. 1858. *Arbuscula bismagarica* Pluk. apud Miq., Fl. Ned. Ind. 2: 867 in syn. 1858. *Gmelina coromandeliana* Burm. f. apud C. B. Clarke in Hook. f., Fl. Brit. India 4: 582 in syn. 1885. *Gmelina coromandelina* Burm. apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1039 in syn. 1893. *Gmelina parviflora* Pers. apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1040 in syn. 1893. *Gmelina integrifolia* Hunter, Journ. Straits Br. Roy. Asiat. Soc. 53: 101--102. 1909. *Lycium maderaspatanum* Pluk. apud H. J. Lam in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 69 in syn. 1921. *Gmelina asiatica* var. *typica* Bakh. ex Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 69. 1921. *Gmelina coromandelica* Burm. ex Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 69 in syn. 1921; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1074 in syn. 1932. *Prunus indica sylvestris fructu flavo, pyriforme* Burm, ex Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1074 in syn. 1932. *Gmelina purvifolia* Roxb. ex Mold., Alph. List Inv. Names Suppl. 1: 10 in syn. 1947. *Gmelina tomentosa* Roxb. ex Mold., Alph. List Inv. Names Suppl. 1: 10 in syn. 1947 [not *G.*

tomentosa Fletcher, 1938, nor Wall., 1817). *Premna indica et sylvestris* Burm. ex Pételot, Pl. Méd. Camb. Laos Viet. 2: 252 in syn. 1954. *Premna indica* Burm. apud Pételot, Pl. Méd. Camb. Laos Viet. 4: 151 in syn. 1954. *Premna sylvestris* Burm. apud Pételot, Pl. Méd. Camb. Laos Viet. 4: 151 in syn. 1954. *Prunus indica sylvestris* Burm. ex Mold., Résumé 341 in syn. 1959. *Gmelina asiatica* var. *typica* H. J. Lam ex Mold., Phytol. Mem. 2: 408 in syn. 1980.

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Illustrations: Pluk., Almag. Bot. Phyt. 1: pl. 14, fig. 4 (1691) and 5: pl. 97, fig. 2. 1700; Pluk., Op. Omn. 5: pl. 97, fig. 2. 1720; Amman, Comment. Acad. Sci. Imp. Petrop. 8: pl. 18. 1736; Roxb., Pl. Coast Coromand. 2: pl. 162. 1802; Poir. in Lam., Tabl. Encycl. Méth. Bot. [Illust. Gen.] 3: pl. 542. 1819; Wight, Illust. Indian Bot. 2: pl. 174 (in color). 1850; Vidal, Sin. Fam. Gen. Pl. Leñ. Filip. [Introd. Fl. For. Filip.] 2: pl. 75E. 1883; Raciborski, Ann. Jard. Bot. Buitenz. 17 [ser. 2, 2]: 24, fig. 11. 1900; Holtermann, Einfl. Klimas pl. 7, fig. 40. 1907; Nieuwenhuis, Ann. Jard. Bot. Buitenz. 21 [ser. 2, 5]: pl. 21, fig. 16 & 18. 1907; Basu, Indian Med. Pl., ed. 1, 3: pl. 738b. 1918; Crevost & Pételot, Bull. Econ. Indo-chine 37: opp. 1294. 1934; Junell, Symb. Bot. Upsal. 1 (4): 91, fig. 140 & 141. 1934; Kirtikar & Basu, Indian Med. Pl., ed. 2, imp. 1, 3: pl. 738b. 1935; Sastri, Wealth India 4: 156, fig. 73. 1956; Nair & Rehman, Bull. Bot. Gard. Lucknow 76: 23, fig. 10. 1962; Kirtikar & Basu, Indian Med. Pl., ed. 2, imp. 2, 3: pl. 738b. 1975.

A large, straggling or scrambling, mostly deciduous (evergreen, according to Corner) bush or bushy shrub, sometimes climbing, very variable in size and habit, often weak, arching or flopping over adjacent shrubs, flat-topped, rather hardy, to about 3 or 4 m. tall, or rarely (when adult) a semi-evergreen tree to 10 m. tall, sometimes even prostrate, usually spiny (especially when young), sometimes entirely unarmed [f. *inermis* (Wight) Mold.], much-branched with basitonic branching; branches decussate-opposite, flexible, yellow-lenticellate, forming flat sprays, often with several main stems crowded together; bark yellowish- or brownish-white, thin, smooth; wood hard, gray, the pores moderate in size, scanty, in groups or short concentric lines, the medullary rays fine, short, regular, not numerous; branchlets horizontal, rigid, often compressed, puberulent or even villosulous when young; twigs frequently much abbreviated and apically spinose, the axillary spines sometimes leaf-bearing; crown spreading; leaves small, decussate-opposite, anisophyllous (one larger than the other in a pair), caducous or early deciduous (reportedly sometimes evergreen or semi-evergreen); petioles 0.5--3 (mostly about 6 mm.) cm. long, slender; leaf-blades membranous or chartaceous, varying from oval or ovate to elliptic, obovate, subrhomboid, or triangular in outline, very variable, mostly 1--9.5 (rarely to 13) cm. long, 1.5--6 cm. wide, sometimes all only 4--10 mm wide and 1--2.5 cm. long [f. *parvifolia* (Roxb.) Mold.], entire or sometimes irregularly and more or less obscurely 1-lobulate, basally mostly acute to cuneate, sometimes rounded, apically acute or obtuse, glabrous or subglabrous on both surfaces when mature, often more or less pubescent when young, dark and shiny above, pale-green, glaucescent, and minutely white-glanduliferous beneath, the glands round, not nectariferous, about 20 per leaf; inflorescence axillary and terminal, racemiform or paniculate, nodding to more or less pendulous, densely pubescent to tomentose or appressed-tomentose, ten to many-flowered; bracts usually rather small, linear or lanceolate, 2 or 3 times as long as the calyx, apically cuspidate, caducous, occasionally large and leafy; flowers large, borne in short or very short 1--5-flowered cymules in mostly terminal, fulvous-tomentose, racemiform panicles 2.5--5 cm. long, caducous, falling after dawn or as soon as picked during daylight hours; peduncles pubescent; calyx cupuliform, about 3--4 mm. long, somewhat contracted apically, externally pubescent-tomentose (the hairs dark-brown and strigose-appressed), glanduliferous, internally glabrous, the rim truncate, very shortly and obscurely 4-toothed, the teeth very small, triangular, apically acute, the nectariferous glands 2 to many, large, bare, antrorse, flattened, discoid; corolla large, yellow or bright-yellow to bright sulphur-yellow or jasmine-yellow, *Allamanda*-like, infundibular and bilabiate, 4--5 cm. long, tetramerous, externally finely pubescent or reddish-tomentose with appressed strigose hairs, internally glabrous, the tube basally narrow and curvate, apically ampliate into a broadly ventricose throat, the limb unequally to almost equally 4-lobed, the lobes ovate, apically subacute, the lowest largest, the upper reflexed; fertile stamens 2, to 12 mm. long; staminodes 2, 5 mm. long; style shortly exserted, 2.5--3.5 cm. long; pollen-grains 3-zonicolporate, subprolate, often syncolpate, 39 x 27 mu (range 39 x 25--30 mu), the endocolpium very faint, the ectine surface reticulate or areolate; fruit drupaceous, ovoid or obovoid-pyriform to subglobose, yellow when ripe, with a watery or soapy exudate, 1.5--2.8 cm. long, externally glabrous, 1- or 2-celled and -seeded; chromosome number: n = 19 or 20, 2n = 38 or 40.

This is a widely distributed and apparently highly variable species found from India, Sri Lanka, and Bangladesh, through Burma and Thailand, to Malaya and Indochina, east to Indonesia, north to southern China, and west (probably only naturalized) to Réunion and Mauritius. It is widely cultivated in various parts of North, Central, and South America, the West Indies, Europe, Asia, and Africa, as well as on some Pacific islands like Hawaii, mostly as a specimen tree in botanical gardens. In a few cases it appears to have become locally naturalized to a limited extent.

The species is based on *Herb. Linnaeus 780/2* in the Linnean Herbarium in London. The lower chromosome count, noted above, is reported by Cave (1961), the higher count by Sobti & Singh (1962. It is to be hoped that herbarium vouchers were made of their material so that the identification can be checked.

It should be noted here that the *G. asiatica* credited to "Auct. (1917)", to Burman (1921), and to Kurz (1902) are synonyms of *G. elliptica* J. E. Sm., while the *G. asiatica* credited to Blanco (1837), to Lam (1980), to Loureiro (1954), to Schauer (1918), and to Wallich (1831) are synonyms of *G. philippensis* Cham. *Gmelina tomentosa* Fletcher (1938) is a valid species, and *G. asiatica* Wallich (1817) belongs in the synonymy of *G. arborea* Roxb. The *Gmelina inermis* of Blanco (1837) is *G. elliptica* J. E. Sm., while the *G. inermis* of Naves (1800) is actually a synonym of *G. philippensis* Cham., although both are often cited in the synonymy of *G. asiatica* L. The *Gmelina hystrix* Kurz, also sometimes included in the synonymy of *G. asiatica* L., actually belongs in that of *G. philippensis* Cham. The *G. asiatica* var. *philippinensis* of Bakhuizen also is a synonym of *G. philippensis*, while *G. asiatica* var. *villosa* of Bakhuizen is *G. elliptica* J. E. Sm.

In connection with the nomenclatural typification of *Gmelina asiatica* L. is should be noted that *Herb. Linnaeus 780/l* is labeled as *G. asiatica*, but actually is a specimen of *G. elliptica* J. E. Sm.; *Herb. Linnaeus 780/2* bears the written comment "*Gmelina*, cand. foliis" in Smith's handwriting, followed by "*asiatica* vera JES// *Jambosa sylvestris parvifolia* Rumph. amb. 1. p. 129. t. 40." *Herb. Linnaeus 780/3* actually is *Flacourtia indica*, but is labeled as "*Gmelina indica* Burm. Ind. 132."

The *Gmelina asiatica* f. *inermis* (Wight) Mold., Phytologia 55: 42 (1984), f. *parvifolia* (Roxb.)Mold., Phytologia 55: 42 (1984), and f. *integrifolia* Mold. [laminis foliorum semper marginaliter integris] appear to represent growth forms of slight, if any, taxonomic significance. The first of these represents plants entirely without spines, the second is a form with the mature leaf-blades only 1--2.5 cm..long and 4--10 mm. wide, and the third is a form whose leaf-blades are uniformly unlobed.

Collectors have described *Gmelina asiatica* on the labels accompanying their specimens as a tall, spreading or tangled, rigid, odorless shrub, 1.5--3 m. tall, or as a much-branched bush, the trunks and branches very spiny, the branching basitonic, the "stems flattened, grooved on both sides" (according to Mueller-Dombois & Comanor), the leaves glabrous, the flowers large, zygomorphic, pendulous, the corolla 2-lipped, the upper lip 3-lobed, "falling after dawn", tubular, incurved, with the lip directed upwards, the "petals overlapping to form an umbrella over the flower" (according to Henry), the fertile stamens 2, the sterile stamens 2, and the fruit pyriform, green to greenish-yellow or green with whitish spots when immature, yellow when mature, the inner pericarp juicy, with a watery or soapy exudate, 1-seeded. The pollen has been described in detail by Nair & Rehman (1962) based on *Herb. Nat. Bot. Gard. 1235* pollen slide *no. 2696*.

Collectors report encountering this plant in dry sandy areas, in dry undergrowth vegetation, in scrub, along hedges, in rocky ground of open deciduous forests, near rivers and on riverbanks, in scrubby deciduous forests, on the bund of tanks, near rock outcrops, in roadside jungles, on sandy exposed soil, and in clay-sand soil of shrub borders, from sealevel to 950 m. altitude, in anthesis from March to January, in fruit from April to August, as well as in October, December, and January. Undoubtedly it flowers throughout the year in its native haunts, and probably also fruits throughout the year, as, indeed, is asserted by Menninger (1970). Cooke (1905) asserts that in the Bombay area it flowers "more or less throughout the year". Pearsall describes it as a "shrubby plant growing almost vine-like"; Sumithraarachchi refers to it as a "common shrub" in Sri Lanka, where Cramer also refers to it as "common in scrub". Cramer, curiously, refers to "pod 6-seeded", probably due to an error in transcription when the labels were prepared. Worthington, also in Sri Lanka, speaks of finding it in areas of 60--90 inch annual rainfall, "but also in scrub in the dry zone and common around the shallow ends of tanks". My wife and I found it scattered at the edge of the jungle near lakeshores. Cooray refers to it as "common". It is described as a nannophyte (Ramamurthy, 1963) or nannophanerophyte (Razi, 1946) in the Raunkiaer classification of life forms.

The corollas are described as "yellow" on *Amaratunga 455* & *1357*, *Comanor 829* & *833*, *Cooray 10031709R* & *68102103R*, *Davidse 7406*, *Fennell 1003*, *Fosberg & Sachet 53* & *58*, *Gould & Cooray 13666*, *Henry 166*, *Hladik 821*, *Liang 79141*, *Moldenke & al. 28226*, *Mueller-Dombois & Comanor 67062307*, *Nafday 118*, *Sumithraarachchi 164*, and *Worthington 5325*, "bright-yellow" on *Bernardi 14357*, *Comanor 592*, *Cramer 4673*, *Fosberg 50237*, *Fosberg & Sachet 52959* & *53060*, and *Fosberg & al. 50933*, as "bright sulphur yellow" on *Amaratunga 318* & *1627*, as "jasmine yellow" on *Townsend 73/41*, and as "RHS [Royal Horticultural Society] Straw Yellow 604/404/1"on *Peele 1389*.

The nectariferous glands are described in detail by Nieuwenhuis (1907). He avers that the large calycinal ones are regularly visited by ants: "Die Zuckerausscheidung findet aud einer einfachen Schicht von Palisadezellen statt." He avers that he never at all observed any ants visiting the small foliar glands and also never observed, either in the field or in the laboratory, any actual sugar secretion from them. He reports ants regularly visiting flower-buds, while sunbirds definitely service the open flowers. Burck observed perforation of the corolla-tubes made by pilfering bees and wasps, but Nieuwenhuis claims that he never saw any evidence of such activity. The same sunbirds that service this tree also service *Bignonia regalis*. Caterpillars do only insignificant damage to the leaves.

Most authors and collectors describe *Gmelina asiatica* as a thorny or spinescent shrub., e.g. Varma (1981), Matthew (1970), and Patel (1971). Jayasuriya refers to it as having the "branchlets spinous at the ends". The Baileys (1976) describe it as "sometimes spiny, the leaves entire or coarsely toothed", while Preston (1969) refers to it as "sometimes spiny, the leaves entire or sometimes lobed". Brandis (1921) speaks of "frequently spinescent branchlets". The illustration given by Raciborski (1900) shows no true thorns, but does show the spinescent twigs. Nairne (1894) asserts that *G. asiatica* is "less thorny than *G. elliptica*". Conspicuously spinose collections cited below include *Bernardi 14357*, *Gould & Cooray 13666*, *Liang 79141*, *Moldenke & al. 28175* & *28226*, *Sumithraarachchi & Jayasuriya DBS.235*, and *Townsend 73/41*.

The situation in regard to entire or lobed leaves is somewhat similar. Woodrow (1910) describes "entire or three-lobed opposite leaves"; Poiret's (1819) illustration depicts a flowering branch with some of the leaves entire and some slightly 3-lobed. On the other hand, Sastri's (1956) figure shows only entire leaves. Brandis (1907) speaks of the leaves as "frequently lobed". Srivastava (1976) refers to the branches as often spinescent and the leaves sometimes more or less obscurely lobulate. Nairne (1894) states that in *G. asiatica* the leaves are "scalloped and shiny", as compared to *G. elliptica* where they are "nearly entire and somewhat hairy". Varma (1981) refers to the leaves of *G. asiatica* as "irregularly and more or less obscurely lobulate".

It is worth noting here that the *König 197* collection, cited below, consists only of fruit. Junell (1934) describes the gynoecium morphology of the genus, based on cultivated material of *G. asiatica* from Kew and *Kajewski 1466*, representing *G. dalrympleana* (F. Muell.) H. J. Lam: "Die Ausbauchungen von den mittleren Partien der Fruchtblätter verwachsen hier wie bei *Tectona* schon im obersten Teil des Fruchtknotens mit den ihrerseits verwachsenen Plazenten. An Längschnitten......sieht man einen Zipfel wie ein Dach über jede Samenanlage vorragen. Dieser Zipfel wird jedoch nicht von den Fruchtblatträndern gebildet. An Querschnitten von Fruchtknoten sieht man nämlich, dass dieser Zipfel innerhalb der Fruchtblattränder liegt. Was man in Fig. 141a in dem oberen rechten Fruchtknotenfach innerhalb des Fruchtblattrandes sieht, ist nämlich keine Samenanlage, sondern dieses Zipfelgebilde. Im Schnitt dagegen kann man die Samenanlage sehen. Auch in dem oberen linken Fruchtknoten fach ist dieses Zipfelgebilde zu sehen. In ben beiden unteren, in etwas tieferem Niveau geschnittenen Fruchtknotenfächern sieht man die Samenanlage, den Fruchtblattrand un den basalen Teil dieses Zipfel. Es ist kein leitendes Gewebe ausgebildet. Dies kann möglicherweise darauf zurückgeführt werden, dass die untersuchten Fruchtknoten sehr jung waren. Obwohl die abgebildeten Querschnitte con dem Teil des Fruchtknotens stammen, der oberhalb der Samenanlagenbefestigungen liegt, sieht man in der Mitte der Querschnitte ein kräftiges Gefässbündel. An Langschnitten von jungen Samenanlagen von *G. asiatica* habe ich gesehen, dass eine Tapetumschicht ausgebildet wird. Der Nuzellus ist im Verhältnis zur Samenanlage sehr unbedeutend und liegt tief in derselben versenkt."

It should be mentioned here, also, that *Lea & Worthington 7103* exhibits unusually large leaves, while *Fosberg & al. 50967* has very tiny leaves and is described as coming from a prostrate-growing plant (it doubtless represents the f. *parvifolia* (Roxb.) Mold. referred to above. *Ripley 378* is said to have had "one variegated twig". *Cooray 68102203R* & *70031809R*, *Mueller-Dombois & Cooray 67072545* & *67121090*, and *Wirawan & al. 899* were collected as vouchers for ecologic studies, while *Ripley 111* & *378* are vouchers for primate ecologic studies with the notation that "monkeys feed on these leaves". A single flower mounted on the United States National Herbarium specimen of *Comanor 592* is of *Bauhinia racemosa*. *Fennell 1003* represents material taken from a cultivated plant grown from seed of *Fairchild & Dorsett 2969* from Guyana. Pollen has been taken from *Comanor 592* (hopefully not from the *Bauhinia* contamination) for study.

Fennell claims that *Gmelina asiatica* "can be grown as a standard, 1 m. tall".

Murray (1784) cites the *Jambosa sylvestris* of Rumpf (1741) and also provides a description in which he adds that the leaves are sometimes 3-lobed. It is most probable that he added this phrase to cover the Rumpf plate which illustrates the typically 3-lobed leaves of *Gmelina asiatica* f. *lobata*. I regard the specimen in Linnaeus' herbarium as the type (holotype) of the species in its typical form. Linnaeus (1753) cites as synonyms "*Michelia spinosa, floribus luteis* Amm. act. petrop. 8. p. 218. t. 18" and "*Lycium maderaspatanum indici, alpino putati aemulum, foliis minoribus & majoribus bijugis, & grandioribus aculeis horridis*. Pluk. alm. 234. t. 303. f. 3 & t. 97. f. 2" with no description except "Habitat in India". Obviously both these pre-Linnean names refer to spinose plants and there is no mention or other indication of lobed leaves. It should be pointed out, however, that the pl. 303, fig. 3, in Plukenet's work, referred to by Linnaeus (above), actually depicts *Gardenia dumetorum*.

Raciborski (1900) maintains a *Gmelina parviflora* (probably a lapsus for "*parvifolia*"), of which he says: "Bei *Gmelina parviflora* sind als abwechselnd die transversal stehended Achselknospen in ihrer Entwicklung bevorzugt, die darauf folgenden vertical stehenden retardiert. Bei anderen *Gmelina*-Arten [*G. asiatica*, *G. philippensis*] ist nur wenig von dieser Regelmässigkeit zu sehen."

The Baileys (1976) regard *G. elliptica* J. E. Sm. as a synonym of *G. asiatica* L. I maintain them as distinct taxa, but admittedly they are very closely related.

Merrill (1921) comments that "The Coromandel form [*G. coromandelica* Burm. f.] is doubtless identical with the Linnean species, but the reference to Sloane probably represents an entirely different plant; I have not seen Sloane's figure."

In this connection the descriptions given by Smith (1810) are most relevant: "1. *G. asiatica*. Linn. Sp. Pl. 873. Burm. Ind. 132. (*Jambusa sylvestris parvifolia*; Rumph. Amb. v. 1. 129. t. 40) -- Leaves roundish, somewhat three-lobed, acute, downy beneath.-- Na-

'tive of Java, Amboina, and other parts of the East Indies. A tree, with straight, roundish, slightly downy branches. Leaves opposite, scarcely two inches long, of a roundish or elliptical form, acute, most generally furnished with a short broad lobe at each side, entire, smooth above; pale and downy beneath; the midrib sending off two principal lateral ones, a little above its base, and several smaller ones higher up, all which are branched. Footstalks downy, various in length, often nearly equal to the leaf, each with a small hairy bud above its insertion, and above that usually a straight, downy, horizontal spine. Flowers in a short, simple, downy, terminal racemus. Calyx downy, besprinkled with several large, shield-like, smooth glands. Corolla large, yellow. Rumphius's figure unquestionably belongs to this plant, but his description seems that of an *Eugenia*. Plukenet's t. 305. f. 3. is certainly *Gardenia dumetorum* and resembles our *Gmelina* only in being thorny: his t. 97. f.2. may possibly be intended for *Gmelina parvifolia*, but is of no use as to determining it."

"3. *G. parvifolia*. Roxb. Corom. v. 2. 31. t. 162. (*G. coromandelica*; Burm. Ind. 132) -- Leaves obovate, undivided or three-lobed, smooth on both sides. -- Common in every forest and uncultivated place on the coast of Coromandel, flowering in October and November. Roxburgh. It is often intermixed with *G. asiatica*, from which it differs in its more humble size, larger and constant thorns, and especially in its smaller leaves, which are smooth on both sides. Their flowers and fruits are alike, the latter being yellow, obovate, the size of a small cherry. We perceive on one calyx in our specimen a solitary gland, like those described in the two former. -- Dr. Roxburgh mentions that cold water, stirred with a leafy branch of this shrub, becomes thick, from the abundant mucilage of the leaves, and is used in that state as a remedy for the heat of urine which accompanies gonorrhoea. Water stirred with branches and leaves of *Pedalium Murex* becomes in like manner mucilaginous, and is used for the same purpose, but soon loses its consistency, which is not the case with such as is prepared with this *Gmelina*. The Telingas call the plant Shieri goomoodoo. It may possibly be Plukenet's *Lycium Maderaspatanum*, t. 97. f. 2, as Burmann takes it to be, but Sloane's *Rhamnus*, Hist. of Jamaica, v. 2. t. 207, f. 1, cannot be the same, though his vile figure affords no distinct indication of what he means."

It should be notes that the *Jambosa sylvestris* of Rumpf, referred to above, is now regarded as applying to *G. elliptica* J. E. Sm.

Ainslie (1826) asserts that *Gmelina asiatica* "was first scientifically described by Professor Gmelin of Petersburgh", but as yet I have not been able to verify this claim -- as far as I know, Gmelin never saw or wrote about this species before Linnaeus. Ainslie goes on to say: "I shall conclude what I have to say of this plant by a remark from Miller; viz., that the *cumbula* of the Hort. Mal. (i.t.75. t.41) is by no means a *bignonia* (*catalpa*), but a genuine species of *Gmelina*, as the fruit evinces."

Walpers (1945) describes *G. parvifolia* Roth as "Fruticosa spinosa: spinis foliiferis; foliis sessilibus cuneatis et obovato-cuneatis, integerrimis vel apice emarginatis vel (ramorum sterilium) majoribus apice grosse tridentatis; racemis terminalibus paucifloris...... Proxima *Gm. Asiatica*, sed differt foliis multo minoribus semipollicaribus pollicaribusve, 2--5 lin. latis, spinis numerosioribus numquam deficientibus racemisque semper terminalibus......Crescit vulgaris in omni ora Coromandeliana." *G. asiatica*, he says, "Crescit in tota fere India orientali". He saw herbarium specimens of the latter, but apparently nothing of the former.

Dietrich (1843) accredits *G. asiatica* to "Ind. or.", but *G. parvifolia* Roxb. to "Java", describing it as "fol. ovatis tricuspidatis simplicibusve subtus glaucescentibus et glanduloso-punctatis et in venis ramulisque puberulis."

It is of interest, also, to note that the name, *G. parvifolia* is accepted and used by Smith (1810, 1820), Voigt (1845), Schauer (1847), Buek (1858), and Naves (1880) for a distinct taxon of specific rank, while *G. parviflora* is used for it by Blume (1826), Ainslie (1826), Sweet (1826, 1832), Loudon (1830, 1832), Dietrich (1837), Don (1839), Walpers (1845), Schnitzlein (1856), Fernandez-Villar (1880), Koorders & Valeton (1900), Raciborski (1900), and Burck (1890). Schauer (1847) says for what he calls *G. parvifolia* Roxb.: "Aff. *G. asiaticae*, sed foliorum figura [subrhombeo-obovatis obtusis emarginatisve postice cuneatis integerrimis vel 3--5-lobis triangularibus obtusiusculis glabratis supra nitidulis subtus glaucis], tomentoque paniculae [farinaceo-tomentosis] corollaque [extus puberula] uberrime diversa." For *G. asiatica* he says: "foliis ovalibus vel subrhombeo-ovalibus triangulari-acutis integerrimis vel utrinque lobo laterali novellis subtus tomentellis.....adultis glabratis supra nitidis subtus glaucis......racemis.....pube appressa tomentosis.....Corolla extus rufo-pubescens." He bases his description of the former on a specimen in the DeCandolle herbarium and of the latter on both live material and a herbarium specimen in the same herbarium.

Gmelina asiatica is said by Raeuschel (1797) to be native only to "India"; Cooke (1905) gives its natural distribution as western peninsular India, Burma, and Sri Lanka; Preston (1969) gives it as only India and Sri Lanka. For his *G. coromandelica* Burman gives the distribution as "Habitat in India ultraque."

For *G. asiatica* Chun (1940) gives the natural distribution, as accepted by him, as India, Thailand, Indochina, Malay Archipelago, the Philippines, and south China (Kwangsi) -- of this, however, the Philippine portion is incorrect (being a misidentification of *G. elliptica*), Ramamurthy (1963) lists it for Madras and Inamdar (1971) found it in Gujarat. Ellis (1966) records it from Andhra Pradesh, citing his *no. 14276*, while Sebastine & Ellis (1967) list it from Madras, citing *Sebastine 10625*. Rao and his associates (1963) found it growing on Rameswaran Island. Martin (1971) lists it for Cambodia, Laos, Vietnam, Thailand, Malaysia, India, and Indonesia. Naithani (1966) reports it "common" in Mysore, citing his *no. 23250*; Pételot (1953) describes it as common throughout Indochina. Thwaites & Hooker (1861) report it as "very common in open places in low country up to 2000 ft." in Sri Lanka, citing *C.P.1952*. Sebastine & Ramamurthy (1966) report it common in Madras, citing their *no. 14669*; Gaussen and his associates (1964) also list it from

Madras. Puri (1960) tells us that it was killed or very seriously damaged by the abnormal frosts in Dehra Dun in January and February, 1905, but in other years it was only "slightly affected" there.

Sastri (1956) asserts that *G. asiatica* is native to the Deccan Peninsula of India and is also planted there; Srivastava (1976) reports it frequently planted in gardens in Gorak for its ornamental flowers, citing his *no. 148*. Prain (1903) describes the plant as "Generally cultivated" in Bengal. Patel (1971) found it in cultivation in Gujarat; Sen & Naskar (1965) also report it cultivated in India, as does Singh (1969), the latter citing his *no. 31993*. Corner (1952) describes the species as "occasional" or "rather scarce" in gardens and villages in Malaya, "certainly not wild". Roig (1953) reports it cultivated in Cuba, Molina (1975) in Honduras, and Van Rensselaer (1948) in California. The Baileys (1976), giving only India and Sri Lanka as its native home, claim it to be hardy in the United States in their growth zone 10. Sweet (1826, 1830, 1839) and Loudon (1830, 1832) claim that what they call *G. asiatica* was introduced into cultivation in England in 1792 from the "E. Indies" and what they call *G. parviflora* in 1817 also from the "E. Indies" -- this seems most unlikely; probably eastern India (Ind. or.) was intended rather than "E. Indies" (East Indies or Indonesia).

Brandis (1907) calls *G. asiatica* "A common bush on the Coromandel coast, south as far as Tutucorin, also inland in the Deccan and Karnatik.....Ceylon." In his 1874 work he says "South India, Ceylon, and Indian Archipelago. Probably in the Central Provinces" and avers that it flowers "nearly throughout the year". Cooke (1905) says of it: "Doubtfully wild in the Bombay Presidency, where it is however extensively grown in gardens and employed for making fences. It is abundant on the Coromandel coast.......It is also common in Ceylon and is cultivated in Bengal." Gupta & Marlange (1961) report it "Probably indigenous in Circars, Deccan, Carnatic and the low country of Ceylon up to 600 m. Planted [in Pondichery] for its beautiful bright yellow flowers." Marlange and his associates (1965) report that it grows "with *Memecylon umbellatum* as dominants in dry evergreen forests on red ferralitic soils in Pondichery."

Burkill (1966) describes *Gmelina asiatica* as "A thorny shrub of the moister parts of India, wild in the south and cultivated in the north; it is apparently an introduced plant in the Malay Peninsula, where it occurs in the more settled parts. Ridley, in arguing that it is introduced, states that it seems not to flower in the southern part of the Peninsula, but this is not [always] the case, as it flowers freely in Singapore."

Gamble (1902) also lists it as native to South India, the Circars, the Deccan Peninsula, and Carnatic, as well as in the low country of Sri Lanka to 2000 feet elevation, adding "elsewhere planted" and citing his *no. C.4336*. P'ei (1932) cites only *Morse 166* from Kwangtung, China, giving the species' overall distribution, as accepted by him, as "British-India, Burma, Siam, Cochin-China, Philippines [erroneous!], Malay Archipelago" and comments that "This is allied to *Gmelina arborea* Roxb. which has much larger leaves and also smaller calyx glands. The leaves in *G. asiatica* L. are more densely yellowish-pubescent rather than bluish-green glandular beneath. The Chinese form has smaller leaves than those of tropical Asia." It would appear that P'ei has confused the two species in this statement, with their characters reversed.

Roxburgh (1814) cites an unnumbered collection presented to him by Dr. Berry in 1799 from Coromandel. Trimen (1895) gives the natural distribution of the species as only Sri Lanka and "South India", flowering there in September. Talbot (1909) gives the selfsame distribution, adding that it is only "Doubtfully wild in the Bombay presidency", but is commonly planted in gardens near Bombay, where it "makes an excellent hedge plant" and blossoms throughout the year.

Hallier (1918) cites *Kamphövener 652* from India, *König 197* from Sri Lanka, *Buitendijk s.n.* from Sumatra, and *Korthals s.n.* from Borneo. He adds: "Mauritius (kultiviert?), Vorderindien! Nach Gamble in Perak, auf Singapore und Java. Nach Rumphius auf Celebes, nach L. S. Gibbs in Indochina and N. O.-Borneo." Prain (1963) assures us that in Bengal it occurs only in cultivation.

Lam (1919) mistakenly reduces *G. bracteata* Burck, *G. finlaysoniana* Wall., *G. hystrix* Schult., and *G. philippinensis* Cham. to synonymy under *G. asiatica*. Actually all these names belong in the synonymy of *G. philippensis* Cham. He cites *Hallier C.124* (as *G. bracteata*) from Banka, *Korthals, Herb. Lugd.-Bat. 908.266-880* from Borneo, and *Elmer 8934*, *Lilles 13*, and *Ramos 338* from Luzon -- these probably all actually being *G. philippensis*. In his excessively broad concept of the species, he gives its overall distribution as Mauritius, the Deccan Peninsula, Ceylon, Bengal, Siam, Philippines, Borneo, Banka, Sumatra, Java, and the Malay Peninsula, but adds "often (always?) cultivated. The species has an affinity with *G. villosa* with which it is confounded, but differs very distinctly from it, among other things by its glabrous leaves."

Dop (1935) cites unnumbered collections of Evrard, Hayata, and Poilane from Annam, of Baudouin, Germain, Geoffray, and Pierre from Cambodia, Balansa and Bon from Tonkin, d'Orléans from Laos, Harmand, Lanessan, Lefèvre, and Thorel from Cochinchina, and of Schomburgk from Thailand. He notes: "souvent cultivé".

Clarke (1885) reports *G. asiatica* "frequent" in the Deccan peninsula and Sri Lanka and cultivated in Bengal, citing only an unnumbered Roth collection. Collett & Hemsley (1890) add Burma to its known distribution, not specifying if wild or cultivated there. Voigt (1845) lists both *G. asiatica* and *G. parvifolia* as cultivated in the suburbs of Calcutta, the former blooming there throughout the year, the latter only in April.

Subramanian & Kalyani (1977) tell us that *G. asiatica* grows in the Southern Tropical Thorn Forest ecologic association along with such other species as *Solanum pubescens*, *Barleria cuspidata*, *Grewia villosa*, *Cipadessa baccifera*, *Rhus mysorensis*, *Atlantia monophylla*, *Tarenna asiatica*, *Dichrostachys cinerea*, and *Phyllanthus polyphylla*. Jayasuriya (1980) reports it "common, chiefly in dry and intermediate lowlands" in Sri Lanka, citing *Worthington 5172*.

Varma (1981) states that *G. asiatica* is "frequently planted as [an] ornamental shrub in gardens. The plant fails to bear fruits in the [Bhagalpur] district" of India, but flowers there from April to September. He cites only *Varma 1479*. Vajravelu & Balakrishnan (1967) assert that it is common in Madras, citing their *no. 20591*, in both flower and fruit in July. Panigrahi & Seran (1968) found it growing "along a small nala near the roadside, probably planted" in Rajapur, citing their *no. 11288*. Sharma and his associates (1975) report it only "occasional" at 950 m. altitude in Tamil Nadu, citing *Sharma 39867*. Sprangers & Balasubramanian (1978) collected it in dry tropical semi-evergreen forests, also in southeastern India.

Kurz (1877) reports the species "Not unfrequent (sic) along choungs in the swamp forest of the Sittang valley (Burma) and near Rangoon", flowering in May. He also encountered it in the evergreen forests of Pegu. Merrill (1921) cites only *Hallier 184* and *Korthals s.n.* from Borneo and *Gibbs 2719* from Sabah, giving the species' overall distribution, in his opinion, as "India to the Malay Peninsula and Java".

Haines (1922) states than in Bihar/Orissa it occurs "Wild or probably escaped on the sandstones near Rairakhol, not far from the town! Often grown in gardens," flowering there from April to June. He notes further that the "Leaves in the Bairakhol plant [are] somewhat fleshy. Calyx and corolla with small glistening glands as well as somewhat pubescent." Kirtikar & Basu (1918) list it from the North Circars, East Deccan, Carnatic, and Sri Lanka, adding that it is "Planted in the Bombay Presidency and Bengal, Burma". Ridley (1923) lists it from Malacca, Singapore, Negri Sembilan, Perak, and Trengganu, but hastens to comment that "I have great doubts as to this being a native here [Malaya]. It occurs sporadically as a shrub, and I have never seen any trace of flowers or fruit, at least south of Tringganu", where he avers that it grows along the seashore. He cites only an unnumbered Scortechini collection from Perak.

In Sri Lanka recent collectors refer to *Gmelina asiatica* as common (Cooray), at least in open forests with trees up to 15 m. tall, on forest edges, and in open tall scrub with scattered clumps of trees and grass between the clumps, very common in the shrub ectone between forests and tanks, growing in light-colored soil. Fosberg & Sachet report it "occasional at the edge of thickets and among tall grass on coarse gritty soil". Other collectors refer to it as only occasional in dense scrub forests and rare in the open belt adjacent to forest margins dominated by low suffrutescent herbs growing in sand. They have encountered it in dryland forests, in dry forests around tank margins, on the brushy coastal hills, in clay sand at shrub borders, in thickets surrounding rock outcrops, on the edges of tank bunds, at the edges of jungles, in soil pockets on gneissitic granite outcrops, in exposed sandy soil, in hedges with various euphorbs, and in moist sand near freshwater ponds among vegetation characterized by the presence of *Calamus*. It is sometimes frequent just above the normal water level of lagoons.

Fletcher (1938) cites from Thailand only *Kerr 7005, 19974*, & *21527*, *Lakshnakara 859*, and *Put 2552*, giving the overall distribution, as accepted by him, as India (type), Burma, Indochina, and Malaya.

It should be noted here that *Gmelina inermis* Wight is based on *Wallich 1816d* from Malaya. Wallich (1831) cites for what he regarded as *G. parvifolia* Roxb. his *nos. 2654* & *2654E* and as a questionably synonymous *G. asiatica* his *nos. 2654B, 2654C,* & *2654D*. His *no. 2654E* he cites as "*Gm. parvifolia* Hb. Ham. e Mirgapur" and his *no. 2654B* as "*Gm. asiatica* Hb. Russel", *2654C* as "*Gm. asiatica* Hb. Madr.", and *no.2654D* as "*Gm. asiatica* Hb. Heyn." In his 1829 work he cites *no. 1818* as "*G. asiatica* L." from (1) "Hb. Heyne" and (2) "Hb. Bot. Calcutt."

The original description of *Premna parvifolia* Roth (ex Dietrich, 1843) is: "fol. ovato-subrotundis integerrimis tridentatisve glabris; racemo terminali. In Ind. or. ♄ Caulis lignosus fruticosus. Flores pedunculati oppositi magni." The original description of *Gmelina parvifolia* Roxb. (ex Dietrich, 1843) is "fol. ovatis tricuspidatis simplicibusve subtus glaucescentibus et glanduloso-punctatis et in venis ramulisque puberulis. In Java. ♄ " The same author gives the original description of *Gmelina asiatica* L. as "spinosa; fol. ovatis tridentatis subtus venosis tomentosis; racemis terminalibus. In Ind. or. ♄ " The tomentose leaf character seems to apply, rather, to *G. elliptica* J. E. Sm.

Because of the obviously many misintrepretation in past literature, it seems worthwhile to quote Roxburgh's (1832) descriptions and discussions of what he regarded as *G. asiatica* and *G. parviflora*.

"4. *G. asiatica*. Willd. iii. p. 313. Shrubby, spinous. Leaves sub-opposite, oval, and somewhat lobed, smooth. Racemes terminal, and from the forks of the branchlets. Bractes small, caducous. Fruit oval. *Jambosa silvestris parvifolia*. Rumph. Amb. i. p. 129. t. 40. Teling. Goomoodoo. Is one of the most common bushes in every uncultivated place over the coast of Coromandel, and in flower and fruit all the year round. Trunk, I cannot say it has any thing like a distinct one, as I have always found it in the state of a large, ramous shrub. Branches numerous, very irregular. Thorns axillary, opposite, horizontal, leaf-bearing. Leaves on the young shoots generally opposite, on the woody branchlets fascicled, petioled, broad oval, or obcordate, irregularly lobed, both sides smooth and shining, from one to an inch and a half long, and about one broad. Racemes from the divisions of the branches, or terminal. Flowers large, yellow, opposite, approximate, drooping. Bractes lanceolate, small, concave, caducous. Corol the upper lip largest. Anthers, all four are two-parted. Stigma two-parted, the lower four times longer and revolute. Nut four-celled, generally two or three of them abortive. The only use this shrub is applied to, is for fences and fuel.

"5. *G. parviflora*. Corom. pl. 2. N. 162. Shrubby, spinous. Leaves obovate, from entire to three-lobed. Racemes terminal. Teling. Shieri-goomoodoo. *Arbuscula Bisnagarica*. Pluk. Alm. tab. 14. f. 4. *Gmelina coromandelica*. Burm. Flor. In. p. 32. Is common in forests, and uncultivated places all over the coast. Flowering time October and November. It differs from *asiatica* in the following respects. 1st. This is always a smaller plant, with much smaller leaves, although growing together on one spot, which is common. 2nd. The thorns are more numerous, and always present. 3rd. The racemes are terminal. 4th. The leaves have the quality of thickening water like those of *Pedalium murex* and *Menispermum hirsutum*. The flowers and fruit are in both the same. The natives employ the water impregnated with the gelatinous quality of the leaves as a ptisan for the cure of the heat of urine in gonorrhoea. Water is also rendered glutinous by the leaves of *P. murex*, by only turning them round in it, but the water soon returns to its original state. The leaves of this plant, *G. parvifolia*, must be gently bruised with the hand in the water and it remains mucilaginous till decomposed by fermentation."

The original description of *Gmelina integrifolia* Hunter is: "*Gmelina integrifolia*, H. (*G. asiatica* L.). Leaves most entire; Raceme simple terminal. Stem: a large shrub, very branchy, with spines awl-shaped, acute, horizontal. Branches spreading, flexile, with spines, opposite decussated. Leaves opposite, decussated, petioled, ovate, obtuse, most entire; above roughish, deep green, below downy. Petioles half the length of the leaves, slender, downy. Racemes simple, terminal, few flowered. Flowers large, yellow; structure as in the generic character. Drupe roundish, smooth, of a greenish yellow. Nut obovate, smooth three celled: one cell barren. Kernels in the fertile cells solitary, obovate, without convex, within flat. This shrub, which approaches in size to a small tree, is very common in hedges, by the road side. The fruit contains a juice of a disagreeable smell, and gives a very permanent stain, of a yellowish brown colour." This binomial, although apparently proposed as a substitution for Linnaeus' *G. asiatica*, seems definitely to apply, instead, in its description to *G. elliptica* J. E. Sm.

Vernacular and common names recorded for *Gmelina asiatica* are very numerous and include the following: adivi gumadi, álamo blanco, an chanh, Asiatic beechberry, Asiatic gmelina, badhára, bagaboboi, baghara, bhadra, bhdara, bhedaira, biddari, biddarie, bulang, bulangan, bulongan, challa-gumudu, cherkumizhi, chirugummudu, coumelon, daem rumcaiji, demata, demette ette, gaeta-demata, gamudu, gáng, gáng tu hú, gatta-demmata, gatta demmatta, gmelin asiatique, gmelina asiatique, gmelina olie, gmeline de Asia, goomoodoo, gopabhadra, gopogombhari, guludu, gumadi, gumhar, gummadi, gumudu, heilpeeren, ivy-leafed bulang, jobo de Asia, kadambal, kajoe mereh, kálishivan, kalshivani, kal-shivani, karu gummadi, kavva-gumudu, kevva-gumudu, kumil, kumizhaniaran, lahan shivan, la̋hán shivan, latkesar, nagphul, nag-phul, neelacomul, neelacoomul-vayr, nelacoomul root, nélãcoomul vayr, nelacoomul vayr, nela goomadie, néla goomãdie, nélã goomãdi vayroo, nela-gumada, nela-kumi, nilacúmal, nilakkumil, nilak-kumazh, nilak-kumizh, nila-kum, nondano, ostindische Gmeline, oval-leaved gmelina, root of the Asiatic gmelina, shieri-goomoodoo, shieri-gumudu, small-flowered gmelina, vikarini, waren, and wareng.

The roots of *G. asiatica* are aromatic and mucilaginous and are or have been employed in local medicine in India as a demulcent, alterative, and slightly bitter astringent, employed in the treatment of gonorrhea, catarrh of the bladder, and rheumatism, and as a blood purifier. In former times the roots were dug only on St. Mary's

Day and then only those that were naturally oriented toward the north could be used. In Goa the root was once used in the treatment of practically every disease and ailment. Ainslie (1813) affirms that "This root, which is mucilaginous and demulcent, the Vytians reckon amongst those medicines which purify and sweeten the blood in cases of depraved habit of body; given in the form of electuary, to the quantity of a tea-spoonful." The young shoots and leaves also are mucilaginous. When bruised they will thicken cold water and this is said to show antibiotic activity against *Escherichia coli* and *Staphylococcus aureus*. The bark is used to aid the fermentation of toddy. The stems are sometimes used for making axe-handles. The wood is used for making fences, churning-sticks, and fuel. The fruit is edible, but not much appreciated. The seeds yield 7.5% of a greenish-yellow, semi-drying, fatty oil which contains palmitic, stearic, arachidic, linoleic, oleic, and ricinoleic acids (Gibbs, 1974). The unsaponifiable water, according to Aggarwal & Soni (1949), contains a sitosterol.

In Cambodia an infusion made from *Gmelina asiatica* is prescribed in the treatment of yaws. A glucosidic substance is reported to be present, but no saponins (Wehmer, 1931). According to Brandis (1907) the plant is useful for hedges. Watt (1889) also reports its use as a laxative and in the treatment of syphilis, but the uses ascribed to the "rais Madre de Deos" of the Portuguese, to Loureiro's "Flora of Cochin China", and to Rumpf's "*Jambusa sylvestris parviflora*" do not apply to the present plant, but apply most probably, instead, to *G. elliptica* J. E. Sm.

Bose (1965) affirms that *G. asiatica* "is amenable to gootie preparation". Kirtikar & Basu (1935) state that "The root is aphrodisiac and expectorant; useful in the treatment of pains in the joints (Yunani)". According to Mueller-Dombois & Comanor the plant is "eaten by elephants" in Sri Lanka.

Crevost & Petelot (1934) say: "Arbust dont les feuilles ressemblent à celles du lierre; les jeunes rameaux renferment un mucilage épais, visqueux, employé pour combattre les ardeurs de la blennorrhagie; l'eau ainsi rendue mucilagineuse ne se décompose pas comme celle que l'on prepare avec le *Pedalium murex*."

Petélot (1953) affirms that "Au Cambodge......la plante entière est ordonnée en infusion contre le Pian (2 poignées dans on litre d'eau environ) et la racine fait partie du traitement de l'incontinence d'urine; on associe alors aux ecorces d'*Hopea odorata* et d'*Hydnocarpus anthelmintica*. Les feuilles et les jeunes rameaux renferment en grande quantité un mucilage visqueux qu'ils cèdend à l'eau froide et dans l'Indie, la macération est utilisée comme émelliente dans la blennorragie pour calmer les douleurs de la miction. La racine est tenue en très haute estime par les Portugais qui la regardent altérante et émolliente."

Gmelina asiatica is parasitized by the mistletoe, *Dendrophthoë falcata* (L. f.) Ettingsh., according to Singh (1962).

Burck (1891) informs us that "Nicht weniger interessant ist das Geschlecht *Gmelina* in Hinsicht des Schutzes, welchen desselbe durch die Ameisen geniesst. Bei den drei Arten hiervon, die ich zu untersuchen Gelegenheit hatte - *Gmelina asiatica* Linn., *Gmelina parviflora* Roxb., sowie eine Art von Banka, die ich *bracteata* benannt habe [=*G. philippensis* Cham.], aus Gründen, die sofort deutlich werden sollen -- finden sich wieder ausschliesslich Nectarien auf den Kelch, aber sie nehmen da einen eigenthümlichen Platz ein. Fanden wir bei den bereits besprechenen Pflanzen [*Ipomoea*, *Faradaya*, *Nyctocalos*, *Fagraea*] die Nectarien stets auf der ganzen Oberfläche des Kelches zerstreut, so treffen wir sie hier ausschliesslich auf der oberen Seite an. Die Blüthen von *Ipomoea*, *Nyctocalos*, *Fagraea* u.s.w. sind von allen Seiten frei, und es besprecht so zu sagen kein einziger Grund, warum eine *Xylocopa* die Blumenkronenröhre allein von der Seite aus anfallen sollte. Bei *Gmelina* ist dies anders. Die Blüthen dieser Gattung sind in traubenförmigen Rispen angeordnet, welche aus dreiblüthigen, sehr kurz gestielt und von einer Bractee gestützten Trugdolden aufgebaut sind. Diese Stellung der Blüthe macht es nun, dass die selbe auf der einen Seite gegen das Anbohren der Bienen durch die Axe der Inflorescenz geschützt ist, sodass allein an der frien oberen Seite Gefahr besteht. Ich halte es für keine zufällige Coincidenz, dass der Kelch allein an der letzgenannten Seite 5--6 grosse Nectarien trägt, und das solche auf der gegenüberliegende Seite niemals gefundun wurden......Die Liebwache von Ameisen wird daher hier in unmittelbarer Nähe der bedrohten Stelle zusammengahalten. Es werden jedoch immer noch bei *Gm. asiatica* ± 20 procent und bei *Gm. parviflora* ± 40 procent der Blumen angebohrt."

Numerous errors occur in the literature of *Gmelina asiatica*. For instance, Fernandez-Villar (1880) lists *G. asiatica* from Luzon ("Vulgaris ad Manilam"), Mindanao, and Panay in the Philippine Islands and *G. parvifolia* from Luzon and Panay, with the vernacular name for both recorded as "talungun". He cites "*G. inermis*, Naves (non Blanco" as a synonym of the latter. The plant to which he is referring here is *G. philippensis* Cham.

The plate 5, figure 3, of Plukenet, Almagest. Phyt. (1700), often cited as illustrative of *Gmelina asiatica*, actually depicts *Gardenia dumetorum* in the *Rubiaceae*. Stickman (1754), Linnaeus (1759), and Hallier (1918) cite *Radix deiparae* Rumpf as a synonym of *Gmelima asiatica*, but it actually belongs in the synonymy of *G. elliptica* J. E. Sm. The "*G. asiatica* L." of Blume (1826) is certainly *G. elliptica*, but his *G. parviflora* Roxb. probably actually is *G. asiatica*.

Chun (1940) cites *Liang 79141* as the first record of *G. asiatica* from Kwangtung province, noting that the so-called Kwangtung locality recorded by P'ei (1932) as the first record is an error, since the collection P'ei cites was actually made at Lunchow, which is located in Kwangsi province.

The Dop (1915) reference in the bibliography (above) is often cited as "1914", the titlepage date. Stapf (1930) erroneously cites the Poiret (1819) reference as "1797" and the Roxburgh (1802) reference as "1798".

The genus *Gmelina* is said to be referred to in Biol. Abstr. 29: 3291 and 30: 3983, but I fail to find any such reference on the pages indicated.

Sebastine (1959) cites his *no. 634* and Ramaswamy (1967) his *nos.*

2404, *2409*, & *1597* from India.

Several authors have provided partial keys through which to differentiate *G. asiatica* from certain other species of the genus as interpreted by them. These keys may be worth reproducing here.

BAKHUIZEN (1921):

1. Inflorescence axillary, 1--few-flowered; calyx 1.5--2.5 cm. long, with large deltoid segments, densely villous within.. *G. uniflora*.

1a. Inflorescence terminal, paniculate, many-flowered; calyx 0.5--1 cm. long, short-toothed to subtruncate, glabrous or with some hairs within.

2. Ovary densely hairy, especially toward the top; flowers with a shade of purple in the center, sometimes bright yellow or bright blue.

3. Leaves more or less densely pubescent beneath; calyx 0.5--1 cm. long, with some long hairs within........... *G. moluccana*.

3a. Leaves glabrous beneath or scarcely pubescent on the veins only; calyx 3--5 mm. long, glabrous within... *G. dalrympleana*.

2a. Ovary glabrous or nearly so; flowers yellow.

4. Trees; inflorescence terminal, erect; leaves large.

5. Calyx glabrous; filaments distinctly hairy... *G. palawensis*.

5a. Calyx densely pubescent; filaments glabrous or with some glanduliferous hairs.

*6. Leaves oblong or subobovate, basally truncate or subcuneate, apically short-acuminate, glabrous or somewhat pubescent on the veins beneath............... *G. arborea*.

*6a. Leaves broadly ovate, basally cordate, apically abruptly acuminate, densely hairy beneath......... *G. asiatica*.

4a. Climbing shrubs; inflorescence subpendulous; leaves small.

7. Corolla large, 4-lobed, apically ventricose, 4--9 times as long as the calyx............................. *G. asiatica*.

7a. Corolla small, 5-lobed, less than 4 times as long as the calyx.................................... *G. lepidota*.

P'EI (1932):

1. Calyx truncate or short-toothed, the teeth not over 1.5 mm. long.

2. Ovary densely pubescent; calyx truncate or with rudimentary teeth; leaves ovate-elliptic....................... *G. chinensis*.

2a. Ovary glabrous or nearly so; calyx dentate; leaves broadly ovate.

3. Erect trees; leaves large, 10--25 x 5--18 cm.; inflorescence erect.. *G. arborea*.

3a. Scandent shrubs (at least when young); leaves small, not over 10 cm. long; inflorescence pendulous............ *G. asiatica*.

1a. Calyx distinctly lobed, the lobes to 11 mm. long.

4. Ovary densely pubescent; calyx with many large glands; leaves large, usually 7--15 x 5.5--7 cm.; inflorescence terminal, dense....................................... *G. hainanensis*.

4a. Ovary glabrous; calyx with usually only a few large glands; leaves small, not over 2.5 cm. long; inflorescence terminal, lax....................................... *G. delavayana*.

* It would appear that the lines numbered "6" and "6a" had the specific names accidentally transposed by Bakhuizen or his editor.

Other authors differentiate these two species as follows:

KURZ (1875):

Flowers 5-merous; corolla 2-lipped, the upper lip short, 2-lobed, straight....................................*G. arborea.*

Flowers 4-merous; corolla-lobes 4, almost equal, the upper one reflexed....................................*G. asiatica.*

COOKE (1905):

Unarmed tree; leaves exceeding 3 inches long, stellate-fulvous-tomentose beneath; calyx-teeth five................*G. arborea.*

Often spinose shrub; leaves less than 2 inches long, glabrous and glanduliferous beneath; calyx-teeth four...........*G. asiatica.*

CORNER (1952):

Trees, not thorny; leaves over 3 inches long, with a long tip....................................*G. arborea.*

Thorny bushes or small trees; leaves 3 inches long or less.

Leaves woolly-felted beneath; bracts green...........*G. elliptica.*

Leaves not woolly-felted beneath.

Bracts large, purplish, 1 to 3 3/4 inches long; leaves up to 3 inches long.............................*G. philippensis.*

Bracts not as above; leaves up to 1½ inches long, often 3-lobed....................................*G. asiatica.*

MOLDENKE (1954):

Leaf-blades large, 18--23 cm. long, usually cordate or subcordate at the base, unlobed; branches unarmed.............*G. arborea.*

Leaf-blades small, 1--5 cm. long, usually acute or acuminate at the base, often 3-lobed; branches often spiny.........*G. asiatica.*

PRAIN (1963):

Unarmed tree; leaves large, ovate-cordate, acute, fulvous-tomentose beneath....................................*G. arborea.*

Shrub, armed or not; leaves small, ovate or obovate, base not cordate, glabrous and glaucescent beneath when mature, with a close coating of minute glands.........................*G. asiatica.*

SRIVASTAVA (1976):

Flowers yellow; leaves 2--5 cm. long...................*G. asiatica.*

Flowers yellowish-brown; leaves 10--23 cm. long.........*G. arborea.*

Material of *Gmelina asiatica* has been misidentified and distributed in some herbaria as *G. chinensis* L., *G. philippensis* Cham., *G. villosa* Roxb., *Premna pyramidata* Wall., and even *Bignoniaceae* sp. On the other hand, *Chin 937*, distributed as typical *G. asiatica*, actually is its f. *lobata* Mold., while *Herb. For. Dept. N. Borneo SAN. 15304*, *Saikeh & Aban SAN.82322*, *Sheehan R.33*, *Siebold s.n.* [Java], and *Toroes 5357* are *G. elliptica* J. E. Sm., *Wilkes s.n.* [Caldera] is *G. elliptica* f. *lobata* (Gaertn.) Mold., *Fairchild 2969*, *Merrill 2932*, *Peterson J.2501*, and *Surapat 357* are *G. philippensis* Cham., *Sumithraarachchi & Jayasuriya DBS.235* is a mixture with something non-verbenaceous, and *Winit 414* is a mixture with *Premna pyramidata* Wall. (as cited by Fletcher) and *P. tomentosa* Willd. *Herb. Linnaeus G.780/3* is the holotype of *Flacourtia indica* (Burm. f.) Merr., with alternate very long spines.

Citations: GUYANA: *Ramasammy 31* (W--2221846). MASCARENE ISLANDS: Mauritius: *Commerson 260* (P). RÉUNION: *Herb. Harvey s.n.*[1846] (Du--

166603); *Herb. Mus. Paris s.n.* (N, P). INDIA: Karnataka: *Ramaswamy 2402* (Ld). Kerala: *Meebold 12702* (S). Maharashtra: *J. Fernandez 88* (Xa). Tamil Nadu: *Wight 2321* (Mu--1367, Pd, S), *s.n.* (N); *Yeshoda 142* (B, N). Union Territory: *Collector undetermined 638* (Br); *Perrottet 422* (Mu--1177, V), *s.n.* [1835] (W--2496345). State undetermined: *T. Anderson s.n.* (Br); *Roxburgh s.n.* (Br, Br). SRI LANKA: *Amaratunga 318* (Pd), *455* (Pd), *1357* (Pd), *1627* (Pd); *Banda & Worthington 6893* (K); *Bernardi 14357* (W--2766763), *15339* (W--2807857); *Collector undetermined s.n.* (Pd); *Comanor 592* (Ac, N, W--2612092, W--2612093), *829* (Ac, N, Pd, W--2612091), *883* (Ac, N, Pd, W--2612097); *Cooray 68102203R* (Ld, N, Pd, W--2612096), *70031809R* (E, N, Pd, W--2656657); *Cramer 4096* (W--2803413), *4673* (W--2877232); *Davidse 7406* (Ld, W--2806296); *Fosberg 50237* (Pd, W--2612094, W--2744536); *Fosberg & Balakrishnan 53542* (Tu, W--2724106); *Fosberg, Mueller-Dombois, Wirawan, Cooray, & Balakrishnan 50933* (W--2633848), *50967* (W--2676613); *Fosberg & Sachet 52959* (Ac), *53060* (Ld, W--2750159), *53158* (Kh); *Gould & Cooray 13666* (W--2574832A); *Hladik 821* (W--2761098); *Jayasuriya 401* (Pd, W--2719875); *Kirmll 226* (Mu--738); *König 197* (Le); *Lee & Worthington 7103* (K); *Moldenke, Moldenke, & Jayasuriya 28226* (Ac, E, Gz, Pd, Tu, W--2764491); *Mueller-Dombois & Comanor 67062513* (Pd); *Mueller-Dombois & Cooray 67062307* (Pd, W--2586013A), *67072545* (Pd, W--2586012A), *67121090* (Pd, W--2612095); *Ripley 111* (Pd, W--2717915), *378* (Pd, W--2717041); *Sumithraarachchi & Jayasuriya DBS.235* in part (Ac); *Sumithraarachchi & Sumithraarachchi DBS.764* (W--2808326); *Thwaites C.P.1952* in part [Galle] (Pd), *C.P.1952* in part [Jaffna] (Pd); *Tirvengadum & Waas 419* (N, Pd, W--2803772); *C. C. Townsend 73/41* (W--2766161); *Wirawan, Cooray, & Balakrishnan 899* (Ld, N, Pd, W--2656633); *Worthington 5172* (K), *5325* (K), *6532* (K). CHINA: Kwangsi: *A. Henry 166* (N, N, N--photo). Kwangtung: *F. A. Mc Clure 378* [Herb. Canton. Chr. Coll. 7201] (Ph). THAILAND: *K. Winit 414* in part (Bk); *P. Winit 414* in part (Bk); *Zimmermann 71* (S). CAMBODIA: *Baker & Baker s.n.* [March 9, '15] (Gg--31095). VIETNAM: Cochinchina: *Pierre s.n.* (S); *Thorel 60* (Ca--53721), *80* (Bz--72807). MALAYA: Penang: *Roxburgh s.n.* [Penang] (Br). Singapore: *T. Anderson 135* (Pd). GREATER SUNDA ISLANDS: Borneo: *Rutten 470* (Ut--22655). HAWAIIAN ISLANDS: Oahu: *Pearsall s.n.* [Barber's Point, June 2, 1950] (Bi). CULTIVATED: Florida: *Fennell 1003* [Pl. Introd. 97933; seed Fairchild & Dorsett 2969] (Ba). India: *Collector undetermined 592* (S); *Nafday 118* (Ba). Pennsylvania: *Peele 1389* (Ba). Sri Lanka: *Moldenke, Moldenke, & Jayasuriya 28175* (Pd, W--2764400). LOCALITY OF COLLECTION UNDETERMINED: *Herb. Jard. Bot. Brux. s.n.* (Br); *Herb. Linnaeus 780/2* (Ld--photo of type, Ls--type, N--photo of type). MOUNTED ILLUSTRATIONS: Amman, Comment. Acad. Sci. Imp. Petrop. 8: pl. 18. 1736 (Ld); Corner & Watanabe, Illust, Guide Trop. Pl. 760. 1969 (Ld); Crevost & Petélot, Bull. Econ. Indo-chine 37: opp. 1294. 1934 (Ld); Poir. in Lam., Tabl. Encycl. Méth. Bot. [Illust. Gen.] 2: pl. 542. 1819 (Ld); Roxb., Pl. Coast Coromand. pl. 162. 1802 (Ba); Sastre, Wealth India 4: 159. 1956 (Ld).

GMELINA ASIATICA f. *LOBATA* Mold., Phytologia 32: 47. 1975.

Bibliography: J. A. Murr. in L., Syst. Veg., ed. 12, 564. 1784;

J. E. Sm. in Rees, Cyclop., imp. 1 [London], 16: *Gmelina* 1 & 3. 1810; Roxb., Fl. Ind., ed. 2, imp. 1, 3: 87--88. 1832; D. Dietr., Syn. Pl. 3: 613. 1843; Walp., Repert. Bot. Syst. 4: 97. 1845; Schau. in A. DC., Prodr. 11: 679. 1847; Miq., Fl. Ned. Ind. 2: 866. 1858; C. B. Clarke in Hook. f., Fl. Brit. India 4: 582. 1885; Brandis, Indian Trees, imp. 1, 509. 1906; Gamble in King & Gamble, Journ. Roy. Asiat. Soc. Beng. 74 (2 extra): 823. 1908; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 64. 1921; Haines, Bot. Bihar Orissa, ed. 1, 4: 720. 1922; Ridl., Fl. Malay Penins. 2: 622. 1923; P'ei, Mem. Sci. Soc. China 1 (3): 119. 1932; Dop in Lecomte, Fl. Gén. Indo-chine 4: 846. 1935; Fletcher, Kew Bull. Misc. Inf. 1938: 204. 1938; T. Cooke, Fl. Presid. Bomb., ed. 2, imp. 1, 505. 1958; Mold., Phytologia 32: 47. 1975; Anon., Biol. Abstr. 61: AC1: 619. 1976; Hocking, Excerpt. Bot. A.28: 171. 1976; Mold., Phytologia 34: 263 & 265. 1976; Mold., Phytol. Mem. 2: 268, 296, & 549. 1980; Brenan, Ind. Kew. Suppl. 16: 130. 1981; Mold., Phytologia 50: 252. 1982; H. N. & A. L. Mold. in Dassan. & Fosb., Rev. Handb. Fl. Ceyl. 4: 395 & 397. 1983; Mold., Phytologia 55: 335. 1984.

This form differs from the typical form of the species in having its leaf-margins conspicuously and uniformly more or less 3--7-lobed.

The form is based on *Wirawan, Cooray, & Balakrishnan 899* from the Smithsonian Camp, Marai Villu, Wilpattu National Park, Sri Lanka, collected on June 30, 1969, and deposited in the Britton Herbarium at the New York Botanical Garden.

It seems most probable that this is only a juvenile form of the species, often also occurring on turions or watersprouts, but apparently sometimes persisting to the mature flowering and fruiting stages of growth. Hunter (1909) regarded the "most entire" leaved form (which I regard as the typical form) as *G. integrifolia* Hunter, although his description seems to at least include also typical *G. elliptica* J. E. Sm. Most of the authors listed in the bibliography of *G. asiatica* (above) refer, in some way or another, to the lobed-leaved form, sometimes with the parenthetical added statement "sterile shoots", but there are some authors [viz., Blume (1826), Kurz (1877), Lam (1919), and Talbot (1976)] who omit any mention of it. In the typical form of *G. asiatica*, in my interpretation of it, the leaf-blades are either completely entire (unlobed) or only obscurely 1-lobulate.

Militating against the theory that the lobed form occurs only on juvenile or otherwise sterile shoots is the fact that the *Chin 937* collection, cited below, is in full anthesis and the *Wirawan & al. 899* type collection is in fruit.

Collectors have found this plant on limestone debris, at 50--100 m. altitude, describing it as a shrub, 2--3 m. tall, the corollas yellow (in March) and the fruit green (in June). Herbarium material has mostly been identified and distributed in herbaria as typical *G. asiatica* L.

Citations: SRI LANKA: *Wirawan, Cooray, & Balakrishnan 899* (Ld--isotype, N--type, Pd--isotype, W--isotype). MALAYA: Perak: *Chin 937* (Kl--19928). Singapore: *J. Sinclair 5556* (W--2912695).

GMELINA ATTENUATA Fletcher, Kew Bull. Misc. Inf. 1938: 203--204. 1938.

Bibliography: Fletcher, Kew Bull. Misc. Inf. 1938: 202--204 & 422. 1938; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 60 & 93. 1942; Hill & Salisb., Ind. Kew. Suppl. 10: 100. 1947; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 137 & 186. 1949; Anon., Kew Bull. Gen.. Ind. 134. 1959; Mold., Résumé 178 & 456. 1959; Mold., Fifth Summ. 1: 296 (1971) and 2: 879. 1971; Mold., Phytol. Mem. 2: 286 & 549. 1980; Mold., Phytologia 55: 335. 1984.

A low shrub, to about 5 m. tall; branchlets tetragonal, variegated with brown, the young parts pubescent and with white sessile glands, later almost glabrous and much less glandulose; leaves decussate-opposite; petioles 0.5--2 cm. long, brown, canaliculate above; leaf-blades chartaceous, elliptic or subobovate, 6--10.5 cm. long, 2--5 cm. wide, apically subacuminate and slightly lobulate, marginally entire and slightly recurved, basally long-attenuate, gray-brown (in drying) and glabrous above, gray-brown (in drying) and slightly pubescent beneath, marked with sessile, round, white glands; midrib and the 3--5 pairs of secondaries inconspicuous above but prominent beneath, the secondaries parallel; tertiaries transverse, strong, numerous, parallel; inflorescence terminal, 2 cm. long, densely fulvous-tomentose; pedicels short, fulvous-puberulent; bracts at the base of the panicle pubescent, the lower ones 15--20 mm. long, the upper ones very small; calyx externally fulvous-tomentose, the tube 4 mm. long, internally glabrous, somewhat sinuate-lobulate; corolla yellow, externally lightly tomentose.

The species is based on *Kerr 6224* from an open grassy forest at Chiengma, Payap, Thailand, at 1100 m. altitude, deposited in the Kew herbarium. The author notes that the species "*G. asiaticae* Linn. foliis biformibus integris et profunde lobatis affinis, sed foliis maioribus basi attenuoribus, inflorescentiae forma differt." The species it known to me only from the original description. Fletcher (1938) differentiates it from the other Thailand species known to him as follows:

1. Inflorescence a small compact terminal panicle; calyx with 4 teeth; corolla with 4 lobes.
  2. Leaves at most 5 cm. wide, strongly tapering at the base....... *G. attenuata*.
  2a. Leaves at least 5 cm. wide, hardly cuneate at the base........ *G. paniculata*.

1a. Inflorescence a large terminal panicle or a small terminal raceme of cymes.
  3. Inflorescence a large terminal panicle; calyx with 5 small teeth; corolla with 5 lobes......................*G. arborea*.
  3a. Inflorescence a small terminal raceme of cymes; calyx with 4 small teeth; corolla with 4 lobes.
    4. Bracts leafy..............................*G. philippensis*.
    4a. Bracts small, linear.
      5. Leaves tomentose beneath.
        6. Leaves elliptic, the mature ones slightly cuneate, faintly pubescent but more often glabrous above.*G. elliptica*.
        6a.Leaves ovate to slightly elliptic, the mature ones deltoid at the base, tomentose above........*G. tomentosa*.

5a. Leaves glabrous or occasionally faintly pubescent beneath.....................................*G. asiatica*.

GMELINA BALANSAE Dop, Bull. Soc. Bot. France 61: 322--323. 1915.

Synonymy: *Gmelina lecomtei* var. *annamitica* Dop, Rev. Internat. Bot. Appliq. Agric. Trop. 13: 896. 1933. *Gmelina speciosa* Mold., Known Geogr. Distrib. Verbenac., ed. 1, 59 & 93 nom. nud. 1942. *Gmelina chinensis* L. ex Mold., Résumé Suppl. 3: 32 in syn. 1962 [not *G. chinensis* Benth., 1861].

Bibliography: Dop, Bull. Soc. Bot. France 61: 322--323. 1915; Prain, Ind. Kew. Suppl. 5, imp. 1, 115. 1921; Dop. Rev. Internat. Bot. Appliq. Agric. Trop. 13: 896. 1933; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 573. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 59 & 93. 1942; H. N. & A. L. Mold., Pl. Life 2: 49. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 136 & 186. 1949; Mold., Résumé 176, 297, & 456. 1959; Prain, Ind. Kew. Suppl. 5, imp. 2, 115. 1960; Mold., Résumé Suppl. 3: 32. 1962; Mold., Fifth Summ. 1: 301, 523, & 524 (1971) and 2: 879. 1971; Mold., Phytol. Mem. 2: 290, 293, & 549. 1980; Mold., Phytologia 55: 334. 1984.

A tree, 7--8 m. tall; young branchlets lightly yellow-tomentellous; petioles slender, 5--6 cm. long, subglabrous; leaf-blades chartaceous, ovate or elliptic to trapezoid, to 21 cm. long and 11 cm. wide, apically acute or obscurely acuminate, marginally entire or obscurely sinuate, basally cuneate, glabrous and shiny above, nigrescent in drying, lighter and at first pubescent, later glabrous beneath, glanduliferous at the base; secondaries 3 or 4 per side, oblique, prominent, straight or slightly arcuate; veinlets very slender, transverse, parallel; cymes few-flowered, arranged in corymbiform panicles, lax, 30 cm. long, lightly fulvous-tomentose, the branching di- or trichotomous; bracts ovate or elliptic, apically acute, basally attenuate; pedicels 5--6 mm. long; calyx broadly campanulate, 1 cm. long, externally glabrous, often apically with some minute black glands, the rim truncate, often with 5 very small or obsolete teeth; corolla yellowish-violet, 2.5--3 cm. long, pruinose, the tube basally cylindric, apically broadly dilated, the lobes 5, subequal, rounded, the largest (on the lower lip) 12 mm. long; stamens 4, subexserted; anthers pendulous, the thecae subparallel, basally acute; ovary apically sparsely pilose; style 14 mm. long, apically sparsely pilose; stigma bifid, the lobes equal; drupes yellow or black, oblong, 1.5 cm. long, 7 mm. wide, apically depressed; seeds 1 or 2.

The species is based on an unnumbered Harmand collection from between Mekong and Hué, Annam, Vietnam, *Spire 233* from Phronthane, Laos, and *Balansa 3806* from Lankok, Mt. Bavi, Tonkin, and *Bon 5413* from somewhere in Tonkin, Vietnam, all probably deposited in the Paris herbarium. *Gmelina speciosa* is based on *Balansa 3806* (above) collected on June 24, 1887 and deposited in the Kew herbarium.

Dop (1915) comments that "Cette espèce est voisine du *Gm. chinensis* Bentham; elle s'en distingue par la dimension des feuilles, les inflorescences et les lobes stigmatiques égaux. Elle se rapproche aussi du *Gm. Lecomtei* dont elle s'éloigne par la forme des feuilles, les fleurs pédicellées et la dimension du fruit."

Dop (1933) later re-named this taxon *G. lecomtei* var. *annamitica*, citing an unnumbered Harmand collection from Hué, Annam, noting that it differed only from what he called *G. lecomtei* [now known as *G. racemosa* (Lour.) Merr,] in its leaves being elliptic or elliptic-lanceolate and the floral pedicels longer. His words are "Dans le travail que j'ai cité précédement.......j'avais decrit a cote de *G. Lecomtei* une autre espèce affine *G. Balansae*. Depuis la rédaction de cette note de naveux et nombreux échantillons reçus par le Muséum m'ont montre qu'il existait entre ce deux espèces tous les intermédiaires et qu'il y avait lieu de réduire la deuxième espèce au rang de variété dont la synonymie c'établira ainsi."

Collectors describe *G. balansae* as a "good-sized" forest tree, 8--10 m. tall, the corollas "yellow with purple", in flower from May to July.

Material of *G. balansae* has been misidentified and distributed in some herbaria as *G. chinensis* Benth., *G. lecomtei* Dop, and *G. racemosa* (Lour.) Merr.

Citations: LAOS: *Spire 233* (B--cotype, Ca--53722--cotype). VIET-NAM: Annam: *Clemens & Clemens 3980* (Mi). Tonkin: *Balansa 937* (K), *3806* (K--cotype, Ld--photo of cotype, N--cotype, N--photo of cotype); *Petélot 1058* (Ca--223728), *1941* (Bz--21327, Ca--259681, N, Qu), *6849* (N), *8484* (N).

GMELINA BRASSII Mold., Phytologia 6: 324--325. 1958.

Bibliography: Mold., Phytologia 6: 324--325. 1958; Mold., Biol. Abstr. 33: 1215. 1959; Mold., Résumé 201 & 456. 1959; Hocking, Excerpt. Bot. A.5: 44. 1962; Mold., Résumé Suppl. 813. 1964; G. Taylor, Ind. Kew. Suppl. 13: 61. 1966; Mold., Fifth Summ. 1: 336 & 338 (1971) and 2: 879. 1971; Mold., Phytol. Mem. 2: 327, 328, & 549. 1980; Mold., Phytologia 55: 336. 1984.

A tall tree, to 30 m. tall, the unbuttressed bole to 13 m. high and 35 cm in diameter at breast height; bark about 6 mm. thick, the outer bark pale- or gray-brown, with shallow or deep longitudinal fissures and dotted with coarse pustular lenticels, the inner bark orange-straw or cream-color, tinged with green on the back, with yellow and white alternating concentric layers within; sapwood 5 cm. deep, pale straw- or pink-straw color; heartwood very pale brown; branchlets obtusely tetragonal, brunnescent, very minutely puberulent or glabrous, with scattered, light-colored, rather prominent lenticels; nodes not annulate; principal internodes 3--4 cm. long; leaves decussate-opposite; petioles rather stout, 2--5 cm. long, very minutely and obscurely appressed-puberulent or glabrous, flattened above, brunnescent in drying; leaf-blades thin-coriaceous, gray-green or dull dark-green above, lighter green beneath, broadly elliptic or almost ovate, 8--25 cm. long, 4--16 cm. wide, apically very shortly acuminate with a broadly rounded acumen, or merely obtuse, marginally entire, basally broadly rounded or subcordate and there marked with 2 very prominent swellings above due to groups of close, flat glands beneath, glabrous on both surfaces; midrib flat above, prominent beneath; secondaries slender, 6 or 7 per side, ascending, slightly arcuate, anastomosing in many loops near the margins.

[to be continued]